METAL INDUSTRY

31 JANUARY 1958

Thermonuclear Fusion

WITH the thrill of pride, not unmixed with wonder, with which all who are technical and scientifically minded read the announcement of the existence of ZETA last week, there must come the question "What is there in it for us?" For the moment, at least, the very name Zero Energy Thermonuclear Assembly indicates that only a microscopic amount of energy is produced from an immense power input. But ZETA is the pioneer apparatus, and clearly the key which will some day unlock vast floodgates of power. ZETA establishes that the energy from deuterium, and indirectly from sea-water, can be tapped and controlled. Development of the assembly as an economic power producer will, as Sir John Cockcroft has been careful to point out, take many years and involve much work, for instance, into the severe heat loadings inherent in "containing" temperatures in excess of the 100 million °C. for "containment times" up to the desired one second. Research in high temperature materials will thus obviously receive a tremendous fillip from which some benefit is sure to be derived by the metallurgical industry.

The prospect of unlimited and cheap electric power alone offers entrancing possibilities. The cleanliness, convenience, and controllability of electricity are already widely appreciated and only cost limits many attractive industrial applications. Now those applications may have greater hope of realization. The extraction of metals by the electrolysis of fused salts, for example, may well extend to other metals than the one or two now obtained by this technique. Electric smelting and the use of vacuum in melting and processing are other applications where cheap power, and the lowering of manufacturing costs all round, which ought to follow, should permit new horizons.

But beyond these more obvious day-dreams, the fascination of temperature measured in millions of degrees, and contained by a magnetic field, must appeal to the minds of all progressive metallurgists. Will dislocations, and lattice imperfections and mosaics, which limit the present achieved strength of metals, become preventable if controlled condensation of metal vapour replaces the traditional freezing of metals? In any case, it is a short step of the imagination for the "pinch effect" principle, and containment of a gas plasma in what has been described as a "magnetic bottle" to be adapted to the idea which has already received some attention—the crucibleless melting of metals.

A point which seems to have received little mention is the fact that the Harwell team has developed a satisfactory means of measuring the fantastic temperatures induced in ZETA's one inch thick aluminium-walled torus. This is the vacuum spectrograph method. By recording the spectrum of the gases in the torus the broadening of the spectrum lines resulting from the immense velocities of the gas atoms enables their velocity, and hence their temperature, to be determined. With the much lower temperatures of industrial applications this technique appears to be almost impossible to apply, but here again a new line of thought has opened and the metal industry conceivably may benefit.

An outstanding factor of the whole conception is the manner in which British and Commonwealth scientists, yet once again, have brought natural forces under the control of man, and led the international scientific world into a new field of knowledge, adding a further lustrous page to the records of major achievements in science, in which they have figured so prominently in the past.

Out of the MELTING POT

Almost Anything

WHAT method(s) would you use to deposit a layer of molybdenum on stainless steel, or a layer of ceramic, a layer of ceramic and metal, a layer of barium titanate, a lubricating coating such as lead monoxide in silver on metal, or a layer of boron on aluminium sheet for use in atomic energy experimentation? The best answer to this question can be given by crossing out the (s) and suggesting the electrophoretic coating method. Apart from providing the answer to the above and many other awkward coating problems, the electrophoretic method, although it has been known, and, indeed, used for specialized purposes, notably in the radio valve industry, still has the advantage of relative novelty and the ready interest that goes with it. The novelty is such that it may even be necessary to follow up the suggestion that this method should be used with the explanation that the method is based on the phenomenon of electrophoresis:—the movement, under the influence of an electric field, of fine particles suspended in a non-aqueous medium and their ultimate deposition on a conducting surface immersed as an electrode in the suspension. In connection with a recent revival of the process in America, with special reference to the coating of stainless steel, Inconel and the like with molybdenum, the advantanges of electrophoretic coating are pointed out as including: absence of gas evolution at the electrodes resulting in uniform adherent coatings of high density, high throwing power, close control over coating thickness (±0·1 mil), rapid and economical deposition (up to 10 gm/coulomb with current densities of only 0·05-0·03 amp/ft^2 at high voltages; coatings of 2-4 mils thick building up in 20-40 sec.). The molybdenum suspension is prepared by ball milling or otherwise comminuting the metal powder in isopropyl alcohol or nitropropane. Additives are included to increase the activity and the stability of the resulting suspension. In the case of suspensions of oxides, ceramics and the like, small amounts of graphite, stannous fluoride or osmium oxide are introduced to ensure electrical conductivity of the deposit and allow its building up. The chief drawback of the electrophoretic process is the weakness of the as-deposited coatings, which necessitates a subsequent sintering or firing treatment. Combinations or sequences of electrophoretic coating and ordinary electroplating for the production of metal ceramic or alloy deposits would appear to be promising and worth investigating.

Direct Link

APART from providing a largely unnecessary shock treatment to those working on the development of classification and electronic information-retrieving systems, little use appears to have been made of the recent statement that in some cases it may be preferable, on the score of time or expense, to carry out an actual piece of research work rather than to try and discover whether it had already been carried out by somebody else and described in the literature. One undertaking that has certainly not been attempted in relation to the above statement is an attempt to carry it to its logical conclusion or to one of such conclusions. In the case of the above statement concerning the relation between research work and the literature search for information, a series of logical steps can be seen to lead to the conclusion that, in view of the relative complexities, durations or costs, research work should be arranged to derive directly from a perusal of the literature rather than that, as at present, an intention of carrying out some research should call for a preliminary search of the literature. In connection with this proposition, it is necessary to consider a little more closely the kind of literature involved. This need not necessarily be current. Quite a number of loose ends worthy of further research will come to light from publications of even appreciable age. Normally, however, the information leading to research will derive from current literature. Naturally, not everything published will lead to further research. This, incidentally, will have the beneficial effect of discouraging the publication of much material that would, in fact, not lead to research. Of course, this linking of research to the literature would mean a radical reorganization of the planning and management of research, but this need by no means be to the disadvantage of the latter. Indeed, the elimination of the yawning gap between research and published information, at present being uncertainly and temporarily bridged on individual occasions by the endeavours of librarians, information officers and such like, is certain to benefit both research and what, after all, is, or should be, its reflection in print.

Like It ?

PROPOSALS for a new nomenclature invariably meet with some criticism and opposition, however unsatisfactory the existing state of affairs, which the new nomenclature is meant to remedy, may be. Examples of this are only too familiar in the field of alloy nomenclature and designations. Similar, though probably much less biased, acrimonious and shortsighted reactions with a correspondingly better chance of ultimate success by way of adoption may be expected to fall to the lot of a possible scheme for systematic alloy phase nomenclature recently put forward after a few years of study on metallography by a subcommittee of the American Society for Testing Materials. The scheme, which has been widely circulated in competent circles for critical comment or the suggestion of alternative systems, is intended to replace the present confusing and, to some extent, overlapping use for this purpose of Greek letters (e.g. α—iron, β—brass), of capital letters, or of chemical formulae such as Mg_2Si. The proposed system is essentially based on the crystal structure (the fourteen Bravais lattices) of the phase. This is designated by a capital letter, e.g. "C" for primitive cubic, "F" for face centred cubic, etc. The letter designated the type of lattice is preceded by a number giving the number of atoms per unit cell, and this, in turn, is preceded (in round brackets) by the chemical symbols of the elements occurring in the phase in significant proportions. These are listed in order of decreasing atomic percentage and are separated by a comma or commas. In those instances where there is more than one structure with the same Bravais lattice and the same number of atoms per unit cell, an additional lower case letter is added, so that different structures may be distinguished from each other.

Skimmer

Presentation of Metallurgical Information

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Giving advice on speaking and writing one's native language is a task that exposes the lecturer or author to criticism from all quarters. The author of this Paper, when it was first presented, stated specifically that he claimed neither greater knowledge nor training than most of his audience. He also emphasized, as he does throughout, that many of the points he makes are matters on which opinion may differ. The Paper was presented to the Birmingham Metallurgical Society and repeated with some modifications to the Sheffield Metallurgical Association.

WHY is the question of presenting metallurgical information important to us? Because, though we are metallurgists, we spend more time writing and talking than in doing anything else, except possibly reading and listening. Robert Southey refers to "the arts scribblative and babblative." When we are not scribbling or babbling we are reading or listening to other people's scribbles and babbles. In our youth, having decided to seek a career in metallurgy, we expose ourselves to intensive instruction for years at a stretch. We attend hundreds of lectures, read book after book and paper after paper, make hurried and often illegible lecture notes, and then submit ourselves to examinations with our minds crammed with the principles of the subject as well as hosts of facts, but with little or no practice in answering examination questions. It is not surprising that one hears complaints on all hands about the inability of candidates (and not only technological candidates) to express themselves in terse clear English. That applies to examinations for professional qualifications, National Certificates, and university degrees. One can understand and forgive in some candidates an immature style, but there is no excuse for bad spelling and elementary mistakes in grammar. It is a bit disconcerting to receive an application for a post from a man who says he is a Bachelor of Science but who puts a t in "batchelor"! But I am not concerned about elementary mistakes that merely amuse. Universities and colleges of technology seem tempted to fall back on the excuse that with so much intensive instruction to impart in metallurgy they just haven't time to look after the students' English. I am reluctant to accept that view. It seems to me that it is not necessarily formal instruction in English that is needed as that every technological subject should be taught by people to whom clear expression of their thoughts is instinctive. Thus the instructor should seize every chance of pointing out more effective ways of presenting information, so that the student almost learns good style by stealth.

But this is much more than a mere matter of passing examinations, which ordinarily do not worry us once we have attained professional standing. What happens to the qualified metallurgist when he has persuaded somebody to pay for his services? How does he spend most of his time? Looking down a microscope? Watching a rolling mill? Taking a furnace temperature? Does the metallurgist work alone? Much of the work that goes on under the control of a metallurgist is done by technicians, as distinct from technologists. The metallurgist's job is to think, and strictly speaking we cannot think except in words, apart from listening to music or enjoying a work of art. We must of course know something about metallurgy, but most of our time is spent in persuading other people to follow the advice or instructions that our specialist knowledge makes us competent to give. Even the humblest of us have to keep records of our work, records that possibly nobody else will ever see, but our efforts fail if on consulting these notes later we cannot ourselves recall all that they were intended to convey. In an emergency, laboratory notebooks may have to be studied by others, and if they are unintelligible then the value of our work is nil.

As the years go by the amount of time spent in reading and writing increases. Letters have to be written, and those received have to be interpreted. A shade more important may be the formal report, on which decisions of the highest consequence may be based. There is this important difference between answering examination questions and writing a report in later life: that whereas the former tend to require answers that have already been expressed by somebody in the books or Papers one has read, the metallurgical report may have to describe situations that have never been described before. There is always the technical literature to be read, and not only read but also understood in its application to our job. I haven't met a metallurgist yet who claimed that he could keep pace with the literature except in a highly restricted field. On top of all this, we attend lectures in various local centres, meetings of the learned societies, refresher courses, with varying degrees of benefit. Have we not often said to ourselves "That lecturer certainly knew his subject but he was not good at putting it across"? Have we not all sat at the feet of people whose names are the very last word on subjects to which they have made original contributions, but whose lectures have been marred by some features that have stood between us and real absorption or enjoyment?

In our daily work we metallurgists will throughout our lives be reporting to somebody, orally or in writing, either to another metallurgist or quite likely to somebody who knows next to nothing about metallurgy. We are dealing all the time with other people, whether they be subordinates or superiors. If we get a communication with muddled words, do we not suspect a muddled mind at the back of it? That may apply equally to the casual conversation in works or laboratory or office and to the most elaborately dressed report. Let us imagine, however, that as metallurgists we do not possess muddled minds (the strain on the imagination is negligible): what we have to do is to convey something from our minds to the minds of other people. Words, figures, photomicrographs, lantern slides, must do more than express; they must convey something from mind to mind.

Thus there is always somebody else involved, and the cardinal point in all presentation of metallurgical information is to keep that somebody else constantly before us as we write or speak. It is of the highest importance to our relations with our fellows that we develop a keen sense of what to say, when and how to say it, and what to leave unsaid. We have to put a case persuasively or facts precisely. Trite sayings, you may tell me, but really I am not convinced that the ability to do these things is common enough. Just as all who drive motor cars think they are good at it, so doubtless many of us think we are able to write and speak well, until we look at our sayings critically, and wonder whether they have affected the other fellow in exactly the way we wanted to affect him. Is it good manners to put him to needless trouble? Of course not. Then we must achieve clarity, avoiding sedulously anything that may be obscure to him. Is it good manners to waste his time? Of course not. Then we must achieve brevity and not suffer, as one writer has put it, from an incurable dysentery of words. Is it good manners to be discourteous to the other fellow? Of course not. Then we must cultivate urbanity and considerateness. You may well say "Surely there is nothing new in all this?" Of course not, but it is surprising how often in such a matter-of-fact subject as metallurgy to-day, these canons are ignored. Listen to what old Aristotle wrote 2300 years ago:

"But since the art of speech aims at producing certain judgments . . . the speaker must not only look to his

words, to see that they are cogent and convincing; he must also present himself as a certain type of person and put those who judge him in a certain frame of mind. . . . For it makes all the difference to men's opinions whether they feel friendly or hostile, irritated or indulgent. . . . To carry conviction, a speaker needs three qualities—for there are three things that convince us, apart from actual proof: good sense, good character, and goodwill towards his hearers."

Aristotle was, of course, speaking of oratory, but the same applies to the written word—not so much to the notebook recording the cold observations of the laboratory, but certainly to the internal memorandum, the letter to an outside organization, and the formal report. As F. L. Lucas of Cambridge has suggested, you can depend upon it that there are always shrewd readers lying in wait between the lines to see whether behind the cleverness and the technique there is evidence that the writer's mood was mean or peevish or petty or vain or false.

Let us, however, look at it from what some people would regard as the lowest level of all: in terms of money. The amount of time that is wasted in reading things over and over again to make sure they are understood, or in arguing about what was really meant in conversation, is astonishingly great. The loss of time due to misuse of the Queen's English is costing us an enormous fortune. Every superfluous word, every vague statement that is not quite understood, every undue separation of subject and verb, is costing money, or at least creating irritation and resistance in the mind of the party to whom the metallurgist (or for that matter any scientist or technologist) is speaking or writing.

There are scores of good books on the proper use of words, and I have drawn upon them freely in the preparation of this talk. I would not, however, advocate a blind adherence to a particular usage merely because some pundit says it is correct, for language and usage are always changing. There is often room for differences of view about the right use of words, but much writing to-day offends even elementary canons of good style. Let me add that I count it very difficult to achieve the ideal clarity and terseness most suited to the particular reader or hearer. I am most critical of my own efforts, especially as much of my writing is destined to be read by people who are not as familiar with technical terms as I ought to be. It is quite a task to put information across to such people without ambiguity, keeping the particular reader constantly in mind. For example, a fault I frequently fight is that my sentences are too long, and my paragraphs are too long. Forcing ourselves to be brief takes longer than being verbose, but our writing gains thereby, as long as we do not sacrifice clarity. You may well ask "Is there any over-all economy if the writer has to spend more time in order that the reader shall spend less?" I believe there *is* an over-all economy, for the ability to write briefly and clearly improves with practice. Lack of that ability may (and often does) lead to more waste of time in explaining afterwards what we really meant. As metallurgists we have a lot of complicated tools, but words are the tools we use most. And how difficult it is to choose the right tool, to keep it in good shape for its proper purpose, and to ensure its most economical use! How helpful it is when thoughts are conveyed to us in words that are not only well chosen and in the most suitable order, but which also give us the exact shade of meaning the user intended us to receive! It is well worth while re-reading what we have written and asking ourselves what possible ways there are of misinterpreting it, or even of failing to understand it.

What I have said so far amounts to this: I approach this subject by request and with all diffidence, as a listener and reader rather than as a writer or speaker. I believe it is important because we use words more than any other tool, because we are dealing all the time with somebody else, and to waste his time or put him to needless trouble or treat him with discourtesy is not only bad manners but costs more than it should. There is such a wealth of good literature on writing and speaking that it is quite impossible for me to cover the ground adequately in a lecture; you can study all that literature for yourselves. I will merely highlight some of the things that have struck me most.

Comparison of Methods

Let us consider for a while the differences between the written and the spoken word. In reading, we can go back a sentence, or a page or two, and re-read if necessary; with listening that is impossible, for a word once spoken has gone, and has had its influence for good or ill. On the other hand, in speaking we can hastily correct a wrong impression, whereas the written word is more or less permanent, and there can be much misunderstanding and even serious consequences before there is time to clarify the position. The advantage of the written word, provided it is clear, is that reliance is no longer placed upon memory. The advantage of the spoken word is that a wealth of meaning can be conveyed by the inflexion of the voice, which is more than can be indicated by all the punctuation marks we possess. That is why even in the written word the final appeal is to the ear and not to the eye. You may retort that we are not writing poetry or literary English, we are recording cold facts and perhaps lukewarm opinions. That is so. The truth of that statement, however, in no way detracts from the truth of this: that it is a very good idea, in reading over what you have written, to hear in your own mind your own voice saying it, and to imagine the reader sitting in front of you listening. "But," you will say, "much of our writing is written to be read, and not to be heard." Granted, but the practice of hearing it in your mind is a fine safeguard against long-windedness, obscurity, faulty punctuation, and illogical style.

Take for example a syllabus of a course of instruction in metallurgy. Nothing could be less literary or more matter-of-fact. The West of Scotland Committee for Technical Education, with headquarters at the Royal Technical College, Glasgow, issued in March 1955 what was called a Scheme of Work in Metallurgy. By the time it reached me it was in galley proof form, so luckily there was opportunity for correction. If I were to read out to you the syllabus for Physical Metallurgy A.1 as it first appeared in print, you would have no difficulty in understanding the Committee's intention, as indicated by the inflexion in my voice. Interpretation of meaning is, however, more difficult if you have to read it for yourselves.

PHYSICAL METALLURGY A.1

. . . Constitution, microstructure, properties and uses of solders, lead-antimony alloys, copper-nickel alloys, brasses and tin, aluminium and beryllium bronzes. . . .

Now when I read this I was completely misled, because I at first took it to mean (1) constitution, (2) microstructure, (3) properties and uses of solders, (4) lead-antimony alloys, (5) copper-nickel alloys, (6) brasses and tin, (7) aluminium, and (8) beryllium bronzes. This seemed to me an extremely odd list, so I read it again. Eventually it dawned on me that my confusion was entirely due to a quite erroneous rule that seems to be taught in the elementary schools: that one should never put a comma before "and." This can never be right when more than two things are mentioned. Listen to your own voice reading such a list: if we speak of two things, say copper and nickel, there is no pause after copper, or any break in the voice: "copper-and-nickel"; but if more than two are mentioned, there *is* such a break: we say "tin, copper, and nickel," not "tin, copper-and-nickel." You will accuse me of being pedantic, and will suggest that it ought to have been obvious to anybody with an ounce of metallurgical sense what was intended. But look at the very next paragraph:

PHYSICAL METALLURGY A.2

. . . Structure, properties, constitution and uses of alloy cast irons, bearing metals, and nickel aluminium and magnesium alloys.

Does this mean three classes of alloys or five? In the particular context it is, of course, rather unlikely that such a student would deal with

the structure and so on of ternary alloys of nickel, aluminium, and magnesium, but one should not mislead one's reader, not even for a fraction of a second. This is especially true if he be an anxious young student, not very familiar with the terminology, trying to weigh up what is in front of him. I showed these paragraphs to a young fellow in his S.3 year and asked him to read them aloud. Sure enough he read the first in the wrong way that I illustrated just now, and he got so confused with the second that he couldn't finish it at all. This question of "ands" and commas can play wreck with proper names, too, such as references to authors in the body of a Paper.

Mention of proper names prompts me to refer to another difference between the written and the spoken word. In reading a scientific or technical journal, the fact that a sentence starts with a proper name never bothers us at all. We may read, for example, "Cook and Richards have applied X-ray examination to the study of the mechanism of cold deformation . . ." and we understand it at once. Even in listening to the speaking voice, this does not introduce much difficulty if the names are as familiar to us as those quoted, but if the names are foreign, and the speaker is not quite clear, or pronounces them in a way that is strange to us, the result can be disconcerting. The lecturer, you see, is familiar with his manuscript, and reads fairly rapidly: "Zappfe has shown that in certain alloys . . ." and you lose his sentence because you couldn't catch the first word, and you say to yourself or to your neighbour "What did he say?" I recall a refresher course lecture in which we were given a history of a subject that was essentially a catalogue of published Papers, mostly by foreigners, and the lecturer started nearly every sentence with the name of the investigators. It would not have been so bad if he had made a slight pause after each name: "Zappfe—has shown that in certain alloys . . ." or better still had he led up to the proper name by some such phrase as "It has been shown by Zappfe . . ." or "On the other hand Krivobok regards this theory as . . . ." In short, proper names may well start a written sentence, but less acceptably a spoken one, for many of the audience might think it was some common noun that they had not properly heard.

There can be a very substantial difference between a Paper that is written to be read and a lecture that is written to be heard. A Paper to the Journal of the Iron and Steel Institute or the Journal of the Institute of Metals is in any case only read aloud in abstract; it is primarily intended for reference, and for cold, critical, and leisurely study by those who are well versed in the particular field. A lecturer, on the other hand, can afford to be rather more conversational in style. His manner and his matter must be attractive to listen to, even if afterwards it looks rather less so in print. He can make skilful use of the pause — and can emphasize certain points, even, if necessary, by repetition in the same or different words. He can, if appropriate, introduce a lighter touch that in print would be out of place in a scientific treatise. If a lecturer writes out his discourse with his mind all the time on how it will look on the printed or written page, and then reads it to his audience, the result is likely to be unhappy, for it will sound as if it is being read. That way breeds irksome monotony of voice, irregular delivery, and lack of attention on the part of those in the audience, who say to themselves "I shall be able to read all this in due course, anyway,"—and never do.

We have been comparing and contrasting the written and the spoken word. Now let us consider them separately, noting how in each category the occasion can determine the way in which metallurgical information is presented.

(To be continued)

Industrial Electrical Equipment

AMONG the very wide range of contracts undertaken by The General Electric Company Ltd. during 1957 are several installations in the non-ferrous metals industry, of which the following are, perhaps, the most outstanding.

The installation of three electrolytic tinning lines at the Velindre works of the Steel Company of Wales Ltd. represents a very substantial increase in the tinplate manufacturing capacity of this country. All the electrical driving equipment for these lines, the first of their type to be made in Great Britain, was supplied by the G.E.C.

One example of furnaces for metallurgical applications and the use of vacuum techniques is a new design of continuous 65 kW pusher furnace for pre-sintering tungsten carbide tool tips which has been supplied to Firth Brown Tools Limited. The single unit is encased in polished stainless steel sheet and reaches temperatures up to 1,000°C.

Increasing interest in vacuum treatment has led to the design and installation of more vacuum furnaces. Their sizes and ratings are now being standardized. Standard furnaces will include a laboratory unit and the smaller types of production units. The former will be quite compact, having working dimensions 3 in. in diameter and 6 in. in height. The latter are intended for applications such as silver soldering, brazing of heat-resisting alloys and the sintering of hard metals, heat-resisting alloy compacts and cermets. These furnaces can also be used for small-scale annealing of titanium and zirconium. The larger types of furnaces for production work, not yet included in the standard ranges, will continue to be supplied as required.

The expansion of facilities for higher technological education requires that technical colleges and universities should provide suitable modern equipment for the training of metallurgists. One useful piece of equipment is a high-frequency installation. A generator with an output of 25 kW has been installed at Nottingham University, and a smaller unit of 7½kW output, complete with a melting furnace table, has been supplied to King's College, London. A recent development in high-frequency heating is the use of a flexible cable to take the output from the set to the work position or to a hand-held coil.

Work in connection with nuclear power has included the study of the properties of slurries or suspensions of thorium and uranium compounds in liquid metals for use in breeder reactors. Other investigations have been directed to the penetration of liquid sodium into graphite and the effect of neutron irradiation on the mechanical properties of graphite.

STANDARD SPECIFICATIONS

British Standard for Wire Brushes (*B.S.*2939:1958). *Price* 7*s.* 6*d.*

HAND and rotary brushes filled with wire are the subject of this new British Standard, which has been prepared by representatives of the wire brush industry, local authorities and hospitals, Government Departments and the Services. The new specification deals with wire scratch brushes, casting brushes, platers' brushes, scrubs, brooms, rotary cup brushes, and with a wide range of types for the removal of carbon, scale, paint, etc., from metal surfaces (when mounted on portable pneumatic or electric tools and on stationary grinders).

Many of these brushes were originally dealt with in War Office Specification No. TG.26, and while the British Standard may thus be regarded as superseding TG.26 it includes, at the request of the manufacturers, many brushes not previously standardized.

With certain limitations, the Committee has framed the requirements in terms which will include hand-drawn and machine-made brushes, in order that the standard can be applicable to the whole output of the wire brush industry.

Copies of the above-mentioned standard may be obtained from the British Standards Institution, 2 Park Street, London, W.1.

Research Progress

Mechanism of Creep

BY RECORDER

HAVING been studied for a considerable number of years, the mechanism of creep can be said still to be incompletely understood. In earlier work, the main emphasis was placed on obtaining from observed data empirical relationships between stress, strain, time and temperature. Apart from the practical utility of such equations, it was also feasible that, could relations between the variables be found that would hold under all conditions and for different metals, the mechanism of the process would be discerned more easily. This approach met with partial success, for Andrade was able to correlate many experimental observations in a single equation of relatively simple form. However, the Andrade equation and others that have been suggested do not always give a sufficiently precise fit with creep data. It has also been found difficult to arrive at the equations from a theoretical basis.

More recently, extensive studies have been made of theoretically possible creep mechanisms although, so far, it has not been demonstrated that any one of these will cover fully the data available. Among the most interesting viewpoints are two that have not yet been shown to be erroneous. Briefly, the first suggests that concentration gradients of vacant lattice sites are set up in a creep specimen under the influence of the applied stress. The vacancies move in accordance with the gradients, setting up a net flow of vacancies (and, consequently, a net flow of atoms in the opposite direction) in such a way that the specimen elongates in the direction of the applied stress. The second theory is based on a dislocation-slip model which supposes that the generation and movement of dislocations give rise to the observed strain. As might be expected, these broad ideas provide variant theories differing in detail. J. Harper and J. E. Dorn, of the University of California, who discuss their results on the creep of aluminium on the basis of both views,[1] have chosen to compare the vacancy diffusion theory of Nabarro and Herring[2] and the dislocation-climb model of Weertman.[3]

Experimental Work

The experimental work described by Harper and Dorn was carried out on aluminium of 99·99 per cent purity. The creep specimens, 0·1 in. thick and ½ in. wide, were machined from cold-rolled sheet, and annealed for 1 hr. at 923°K. As might be expected, large recrystallized grains were formed, most of which extended completely through the thickness of the sheet, with an average grain diameter of 3·3 mm. in the plane of the sheet. The creep testing was done at a temperature of 920°K., i.e. about 13° below the melting point, and at low stresses in the range 2-37 lb/in². In some of the experiments, the creep was induced using constant stress loading, in others a constant load was employed. Since the strains were small, this difference in mode of stressing did not preclude comparison of the two sets of results. The test temperature was maintained within ±1°K. over the gauge length of the specimens which, by means of "a series of preliminary tests" was shown to be 3·978±0·035 in. It is also stated by Harper and Dorn that they believe their equipment to be "sensitive" to strains of less than 0·00001 although the movements were measured with a dial gauge having a least-count of 0·0001 in.

Results

Although no information is given about the reproducibility of the results, consistent variations in creep strain were obtained as the applied stress was varied. The creep curves obtained showed that at stresses at least as low as 6·55 lb/in², primary or transient creep occurred for a short period after loading, followed by steady-state creep. At lower stresses the specimens were heated to the test temperature under load so that the initial parts of the creep curves could not be determined. At a stress of 2·8 lb/in², the specimen actually contracted at an almost constant rate. This phenomenon, observed previously in metal wires held at temperatures near the melting point, is due to surface tension forces. Considering the trend of the results at the lowest stresses, Harper and Dorn conclude that the influence of surface tension would have been exactly balanced by an applied stress of about 3 lb/in². Accordingly, the effective tension stress operating in any of the tests was taken to be about 3 lb/in² less than that calculated from the load.

In passing, it may perhaps be suggested that the value of the stress required to counteract surface tension appears to be unduly high. By using an expression derived by Fisher and Dunn, the surface tension can be calculated from Harper and Dorn's data, and the result appears to be of the order of 100 times larger than the probable true value.

It was found that a plot of the steady-state creep rate against applied stress gave a straight line for stresses less than about 16 lb/in². Above this value, however, the creep rate increased rapidly as the stress was raised. According to the Nabarro-Herring theory of creep, a linear relation between creep rate and stress is predicted, so that at the lower stresses it appears possible that creep was occurring by this mechanism. If this is accepted, however, it must be admitted that a different mechanism makes an increasingly important contribution to the deformation occurring at higher stresses. Similarly, the dislocation-climb model predicts a linear relation between creep rate and the fourth power of the applied stress, a condition conforming with the data obtained at the higher stresses but inapplicable to the results at the lowest stresses.

Harper and Dorn are reluctant to conclude from the above that both mechanisms may operate, but at different stress levels. Unfortunately, the difficulty cannot be resolved by measurement of the activation energy of creep, since both theories predict that this will be equal to the activation energy for self-diffusion. By determining the effects of small temperature changes on the steady-state creep rate, Harper and Dorn deduce that the activation energy for creep in their experiments was about 35,500 cal/mole with net stresses of 7·55 and 33·55 lb/in².

Subsidiary Experiments

The results of other subsidiary experiments, however, indicate that the Nabarro-Herring model will not account for some of the phenomena observed in the low stress range. For instance, a grid ruled on a specimen was used to measure the local deformations occurring, particularly near grain boundaries. As such boundaries are the most probable sites of vacancy formation or elimination, it might be expected that the vacancy flow of the Nabarro-Herring mechanism would occur between the grain boundaries. Specifically, the vacancy flow would consist of a vacancy migration from boundaries situated more or less transverse to the direction of the applied stress to boundaries lying in that direction. At positions remote from the boundary no net accumulation of atoms or vacancies would occur, and this material would thus not be "deformed." Near the transverse grain boundaries, however, an apparent "accumulation" of atoms would occur so that the overall creep strains would be attributable to the accession of material to these areas. In specimens tested at 920°K. and a net stress of 10 lb/in², no significant difference in

(*Continued on page* 96)

Pressure Die-Casting Review

Die Temperature Control

IN a Paper presented to the Second International Pressure Die-Casting Conference in Paris last year, Dr. A. F. Bauer, of the Doehler Jarvis Division of the National Lead Company, said that "It must be mentioned that in spite of the most modern temperature recording instruments the control of the die temperature is still far from satisfactory, because it is still only accomplished by manual adjustment of the die cooling water. If the operator slows down his cycle speed, or interrupts the production a few minutes for a coffee break, he often forgets to adjust the water cooling. The result is inferior quality and a number of rejects until the die regains its normal operating temperature."

Some recent developments, entirely British in origin, may well bring control of die-casting machines via the die temperature into everyday use, and go far to overcome the loss of production experienced through scrap when starting from cold. Other claims for the new control device include a faster and more consistent operating rate for any die set, and the production of the best castings of which the die is capable. In this context, a case may be quoted in which a die, with an impression giving relatively large area and thin section, was quite useless until tried with the die temperature control system. It is now producing 1,500 castings in a nine-hour shift without giving rise to any untoward difficulty.

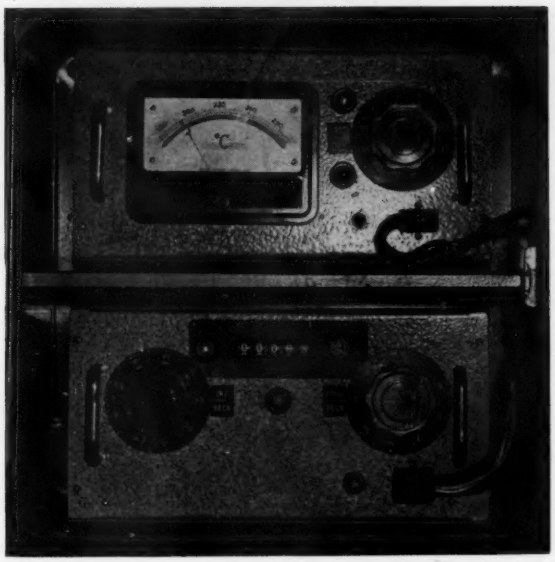
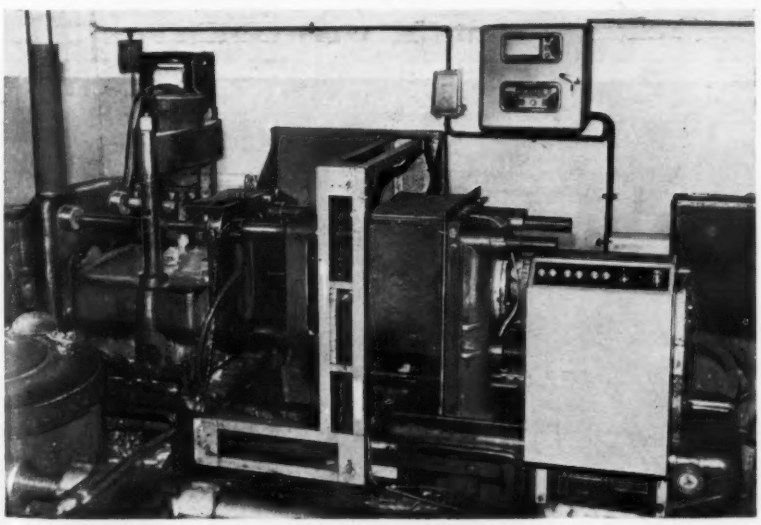


Fig. 1 — The wall cabinet containing the instrument (above) which indicates the die temperature and the control instrument (below) for the machine sequence

A further point worthy of consideration is that the temperature control enables the finish to be maintained at "plating quality," with improvement in the actual strength of the casting. In some production runs on Reed-Prentice and Schultz die-casting machines a reduction in scrap of 50 per cent was achieved in casting for subsequent plating.

A further development which has aroused much interest in the die-casting industry is the introduction of a guard which permits die-changes to be undertaken without the necessity for its complete removal and re-setting each time. Both these developments have been introduced by the Rushton Organization, and extensive production tests have been given to the equipment by Archibald Kenrick and Sons Ltd., of West Bromwich, at whose works an E.M.B. No. 12 machine has been equipped with these devices. A variety of castings is being produced on this machine, including the Shepherd Castor wheel and body.

Fig. 2—E.M.B. No. 12 die-casting machine equipped with die temperature control and machine guard, showing the control instruments mounted on the wall at the rear. The connection from the resistance thermometer can be seen above the fixed half of the die. The guard panels have been removed, showing the guard frame and the slide on which it operates



Temperature Control Device

In principle, the die temperature control device is quite simple. A hole is drilled at a carefully chosen position in the die, its blind end being taken to within $\frac{1}{2}$ in. of the die cavity. The optimum position for this is calculated from the known die data and the nominal heat transfer within the die. Into this hole is fitted a "Thermistor" resistance thermometer which uses a button of semi-conducting material to register the temperature and give a rapid response. The "Thermistor" is mounted in a tube which is inserted in the hole in the die, and is spring-loaded to maintain contact between the "button" and the die-block. This "Thermistor" is connected to a wall cabinet containing two instruments (Fig. 1), the upper of which indicates the die temperature and operates the electrical interlock which prevents the operational sequence beginning until the die temperature is correct. The lower instrument controls the injection and cooling sequences and records the number of shots.

First consideration of this method of

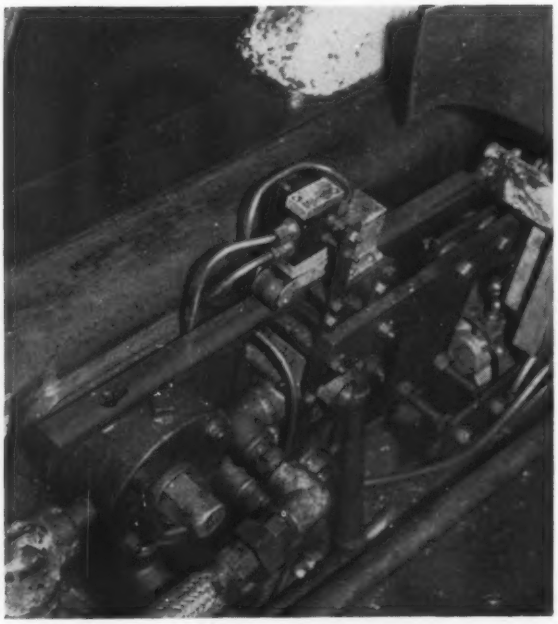


Fig. 3—The interlock slide which prevents the injection cycle beginning until the guard is closed

control may give rise to the objection that it is likely to slow down machine operation by preventing die closure until optimum temperature is achieved. This is not the case, however, since a normal machine has to be set at a time sequence sufficiently slow to avoid die overheating; thus, a fairly long cooling time is used. With the Rushton system it is possible to set timing sequences for high temperature operation, allowing the control to bring down the actual operating rate to the optimum for the die, which is usually found to be faster than would normally be achieved.

Perhaps the most significant gain in production claimed for control through die temperature is the elimination of early morning scrap, when the machine has to be worked up from cold. With this device the machine is started up without cooling water, thus in a short time, some 50 shots, optimum casting conditions are obtained. As soon as this condition is reached a red light indicates that the temperature has been reached and the cooling water can then be turned on, normal sequences following.

At present, control of cooling water flow is left in the hands of the operator, but work is being carried out on a further modification which will enable the water to be turned on automatically as the operating temperature is reached, and, if the die temperature falls too low, water would be automatically cut off from the die cavity, but not from the sprue or spreader.

Although the major production tests have been carried out with the co-operation of Archibald Kenrick and Sons Ltd., on an E.M.B. machine, the control unit can be fitted to any type of die-casting machine, manual or semi-automatic. The "Thermistor" itself and the control unit are rapidly replaceable, or interchangeable from one machine to another, and the adaptation to a given die-set takes only a very short time.

Machine Guard

All die-casters are familiar with the problems arising from the use of machine guards and, in spite of factory regulations, it is by no means uncommon to find guards pushed aside or left dismantled altogether after a die change. In an effort to meet this problem the Rushton Organization has produced a guard which does not hinder die changes and which is interlocked with the die-closure mechanism so that it is impossible to close the dies unless the guard is in position.

The basis of the design is the frame (Fig. 2), which slides on rollers along a guide bar at the base of the machine. Attached to the base of the frame is an interlock slide, shown in Fig. 3. This has at one end a hole into which a pin drops when the guard is closed. Until the guard is closed this pin prevents the operation of the valve for die closure. There is a similar interlock on the injection valve.

The guard panels, of light alloy, are mounted on to this frame with quick release fasteners of the type used on aircraft cockpit covers. An electrical circuit is incorporated into the panel fastenings so that the machine cannot be operated unless the panels are in position. There is thus no possibility of the machine being accidentally set in motion while the guard is open or the panels are not in position.

For die-changing, it is only necessary to remove the panels in order to leave ample space for removal and replacement of the die-set. In all die-casting machines, alignment of the dies can only be assured if the machine can be opened and closed, and for this purpose "inching" is possible while the guard panels are off, using the manual controls. This permits the proper location of the die set, while

Fig. 4—The guard panels in position; guard open

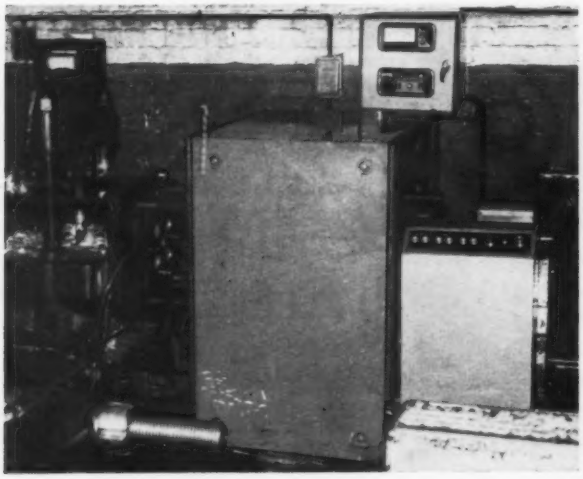


Fig. 5—The guard in its fully closed position

eliminating any danger of an operator being jammed between the closing dies. The removal of the die panels does not interfere with the setting of the guard interlocks, so that, on replacement of the guard panels, the system becomes fully effective at once (Figs. 4 and 5).

The guard is provided with its own air cylinder operation, interlocked with the die-closing mechanism as described. The large clearances between guard and die-set allow adequate room for all normal and even elaborate core-pulling facilities. For unusually long cores, special panels can be constructed. Around all edges of the guard is a rolled rubber bead which further protects the operator.

In Figs. 4 and 5, the control panel as fitted to the E.M.B. No. 12 machine is shown. The three pairs of control buttons are as follows (left to right)—Guard open, Guard close; Dies open, Dies close; Cores in, Cores out. The two large knobs on the right are for auto cycle "on" and "off."

A new company, Rushton Controls, is being formed to develop the die temperature control, patents for which have been filed in the principal countries of the world. Novel features of the guard are also the subject of patent protection.

Acknowledgments are due to Archibald Kenrick and Sons Ltd., West Bromwich, and The Rushton Organisation Ltd., 173 Clarence Gate Gardens, Glentworth Street, London, N.W.1, who provided the information and illustrations on which this article is based.

Production Engineering Research

IMPORTANT developments which took place at PERA during 1957 included the occupation of a new research block and the creation of a new education and training department. More than 120 large and small firms in a wide range of industries joined the association during the year.

General investigations were carried out into impact (cold) extrusion of steel, deep drawing, automation, vibration, friction and lubrication, machine tools, deburring, finish blanking, cutting fluids, tool materials, etc. About 230 special problems and development projects were also undertaken for individual member-firms. These included performance of ceramic cutting tools, cold extrusion of aluminium and steel components, machining of stainless steels, Nimonic alloys and titanium, finish blanking of high-tensile steels, vibration of machine tools and other production equipment, grinding of cutting tools, etc. In addition, members requested technical assistance with about 2,600 specific problems on most aspects of production, including works layout, finishing, mechanical handling, welding, work study, design for production, inspection, etc.

Following the success of last year's courses for key personnel in industry, all the educational activities of the association have been grouped into a new education and training department, and permanent training facilities have been established in the former research laboratories. Greatly improved lecture theatres, demonstration bay, etc., are, therefore, now available for all courses, and equipment has been specially allocated for practical demonstrations of production techniques.

Research has been continued into the finish blanking technique, which produces pressings with smooth edges in contrast to the relatively rough edges produced by conventional blanking techniques. This technique frequently eliminates expensive shaving or machining operations in the production of pressings and is being applied in a growing number of industries in the manufacture of cars, electrical goods, etc. Still wider application of the technique is expected when work on other materials is completed.

It is not generally realized that present limits of feed, speed, tool life, surface finish, and accuracy in many production operations are often set by the vibration characteristics of machines and cutting tools. The difficulties caused by vibration are usually readily apparent in operations such as boring and milling, but in many apparently vibration-free operations the limitations on output and quality are, in fact, often imposed by minute, undetected vibrations.

By using experimental vibration

Part of the interior of the workshops and laboratories of the Production Engineering Research Association

absorbers now being developed by PERA, excellent surface finishes can be produced in some machining operations under conditions which otherwise result in severe chatter, rough surfaces, and, in extreme cases, tool breakage. Other investigations have indicated that the reduction or elimination of vibration often obviates the need for subsequent finishing operations such as reaming or grinding, thus reducing machining times and costs.

Investigations have been continued to determine the relative efficiency of a number of lubricants when deep drawing various materials. The results of this investigation are expected to provide a reliable basis for the comparison of a wide range of lubricants which are at present selected largely by trial and error. Continuation of work in another deep drawing investigation has confirmed that depth of draw can be increased under conditions which differ markedly from conventional practice.

Operational research is being carried out into a wide range of automation equipment. A report on hoppers and selector devices was recently issued to members, and subsequent reports will cover work loading equipment such as magazines; mechanical hands; iron hands; work clamping equipment; work conveying equipment; the application of various types of automation equipment in machining and pressworking operations; and transfer machine tools and presses.

Very heavy demands were made on all information services in 1957. Nearly 2,000 technical enquiries were answered, and approximately 700 requests for information on a wide variety of subjects were also dealt with.

Men and Metals

It is announced that **Mr. D. L. Campbell** has been appointed managing director (sales) of the Metallurgical Equipment Export Company Limited.

To be general manager of their new associated manufacturing company to be established during the current year within the environs of Sydney, Australia, Foundry Services International Limited (one of the companies within the Foseco group) has appointed

Mr. B. Howard Williams. Mr. Williams joined the Foseco organization seven years ago after gaining wide experience in the steel industry. He is a member of the Institute of British Foundrymen.

Owing to ill-health, **Mr. F. W. Rumball** has retired as works director of the Flexile Metal Company but will continue as an outside consultant. **Mr. E. A. Thorne** has been appointed general works manager to the company.

At the annual meeting of the Sheffield Metallurgical Association, held last week, **Mr. R. C. Baker** was elected President for the ensuing year. **Professor A. G. Quarrell, Mr. W. C. Heselwood, Mr. J. E. Russell** and **Dr. A. H. Sully** were elected as vice-presidents.

Changes in the high-level personnel of the Atomic Energy Authority were announced by the Government last week. **Sir John Cockcroft** will give up his post as chief of the Harwell Establishment but will continue to be the Authority's member for scientific research. Sir John will be succeeded as director at Harwell by **Dr. B. F. J. Schonland,** the present deputy director at the establishment. Dr. Schonland was previously director of the Bernard Price Institute of Geophysical Research at Johannesburg. **Mr. W. R. J. Cook,** knighted in the New Year Honours List, and who is at present deputy director of the Atomic Weapons Research Establishment at Aldermaston, is to be a full-time member of the Authority for a period of five years.

In succession to **Mr. Keith H. Ellson,** who was recently promoted to home sales manager of Geo. Salter and Company's balance division, **Mr. Kenneth J. Carter** has been appointed Midlands sales representative, balance division, of the company.

Flying to the U.S.A. for a three-week tour this week are **Mr. L. W. Stubbs,** sales director, Albright and Wilson (Mfg.) Limited, **Mr. A. H. Loveless,** technical director, and **Mr. A. McL. Aitken,** technical sales manager, Kanigen department of the company. The itinerary of the visit includes Chicago, Los Angeles, Sharen (Penn.), Dunkirk (N.Y.), Buffalo, and New York.

Appointed a director of Albright and Wilson Limited, **Mr. W. Carter** joined the company in 1940 and, after filling a succession of positions on the

management side of the company, was appointed the first managing director of the operating company, Albright and Wilson (Mfg.) Limited, on its formation in 1957.

Following the completion of the acquisition of the Fletcher Miller group by C. C. Wakefield and Company Limited, the following appointments to the boards of these two companies, and to that of Wakefield-Dick Industrial Oils Limited, are announced as follows:—C. C. Wakefield and Company Limited, **Mr. S. R. Miller** (chairman of Fletcher Miller Limited); to Wakefield-Dick Industrial Oils Limited, **Mr. A. George** (director and secretary, Fletcher Miller Limited) and **Mr. R. T. Miller** (director, Fletcher Miller Limited); and to Fletcher Miller Limited, **Mr. J. C. Cragg** (manager, Stanlow Works, C. C. Wakefield and Company Limited), **Mr. J. W. MacMahon** (general manager, Industrial Lubricants Division, Wakefield-Dick Industrial Oils Limited), and **Mr. L. J. Windridge** (secretary, Wakefield-Dick Industrial Oils Limited).

Head of the Department of Industrial Administration at the College of Technology, Birmingham, **Mr. David H. Bramley,** M.I.Mech.E., has joined the board of Geo. Salter and Company Limited. He will continue to hold his college post. In 1947, Mr. Bramley was chosen to set up the department of which he is now head. He is a founder-member of the British Institute of Management, and in 1951 was a member of the Anglo-American Council on Productivity team which investigated the training of supervisors in the United States.

It has been announced that **Mr. W. D. Wilson** has been appointed a director of Rhodesia Copper Refineries, Rhokana Corporation, Rhodesia Broken Hill Development Company, Nchanga Consolidated Copper Mines, and Bancroft Mines. **Mr. D. A. Etheridge** has been appointed his alternate.

A member of the board of the company since 1947, **Mr. H. F. Marshall,** M.A., T.D., has taken over responsibility for the Metal Finishing Division of The Pyrene Company Limited. He succeeds **Mr. W. E. Wright,** F.C.S., who retired from the board and from control of the Metal Finishing Division, at the end of last year. Starting some 30 years ago with the original Parkerizing process, Mr. Wright and his colleagues did much to make the British engineering industry "rust-proofing" conscious.

New Plant & Equipment

Barrelling

IN its standard form, the Roto-Finish DW 16/16/2 barrelling machine now incorporates six improved features. It is fitted with a Venner PT.4 repeating process timer; the lever type door locking mechanism is replaced by a more convenient and efficient centre locking door; the new door also incorporates a T-section fabricated gasket of special rubber, with a sealing width of $\frac{1}{8}$ in., which enables high sealing pressures to be obtained, with minimum effort on the part of the operator, by finger tightening, obviating any possibility of leakage; an improved limit switch which cuts out the motor on a small initial movement of the guard; a reversing switch and a variable speed drive have also been built into the modified design.

The machine is one of the products of Roto-Finish Limited, Mark Road, Hemel Hempstead, Herts.

High-Speed Cutting

FOR high-speed cutting of bars, tubes and sections, a combined abrasive and friction cutting machine of Italian design, the Rapto B1, is being marketed by The Addison Tool Co. Ltd., 10 Old Street, London, E.C.1.

This machine can be used with the steel disc or with the abrasive cut-off wheel. The change of speed is effected by belts on a double set of pulleys. Belt tensioning is effected by means of a special eccentric belt tightening device. The rapid opening of the belt guard permits a swift changing of belts and the disc can be changed quickly by easy access through the disc guard.

When cutting with an abrasive, it is necessary to clamp both sides of the cut and for this reason the machine is equipped with a double vice with rapid locking screws. The vice has a graduated scale which permits cuts up to 45° right and left, and can also be slid forward and backwards to suit the material. The vice can be locked to the base by means of a projecting handle.

The spindle, mounted on high speed ball bearings, works in an oil bath, which guarantees the certain and constant lubrication necessary for long working life. Two special sealing rings avoid leakage or loss of oil.

The 5 h.p. motor can be furnished for any voltage and frequency desired.

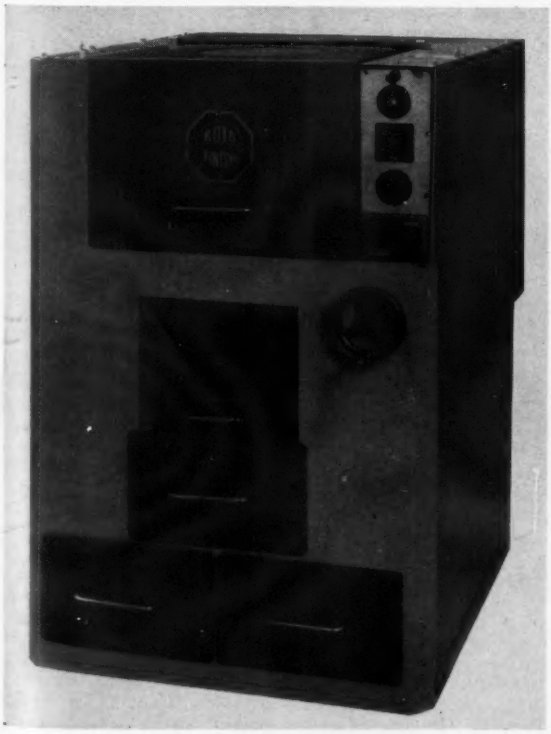
A depth stop is provided so that partial cuts of any depth can be accomplished.

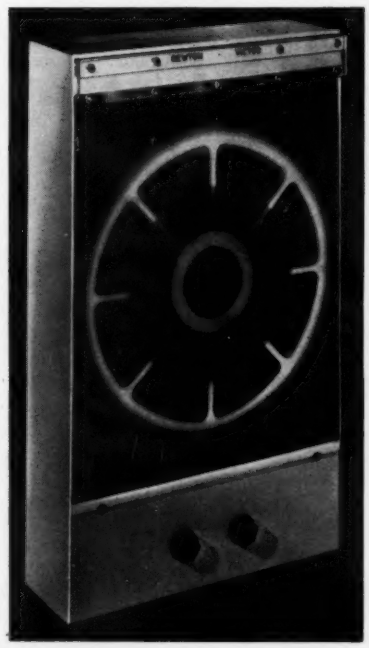
Suitable for cutting up to $\frac{1}{8}$ in. thick with the abrasive wheel, and solids up to $\frac{3}{4}$ in., or tubes of 3 in. diameter (maximum thickness of material $\frac{1}{8}$ in.) with the friction blade, the machine has a 12 in. diameter disc with speeds of 5,100 and 7,000 r.p.m. It is also manufactured for a 16 in. disc. Such machines can cut solid rod up to 2 in. diameter.

Radiography

A NUMBER of improvements ensuring greater accuracy and convenience for the critical examination of X-ray negatives has been incorporated in the "Maxilume" illuminators, recently introduced by Newton Victor Ltd., X-ray department of Metropolitan-Vickers.

A feature of the illuminators is the use of 15 watt colour-matching fluorescent lamps giving an evenly diffused,

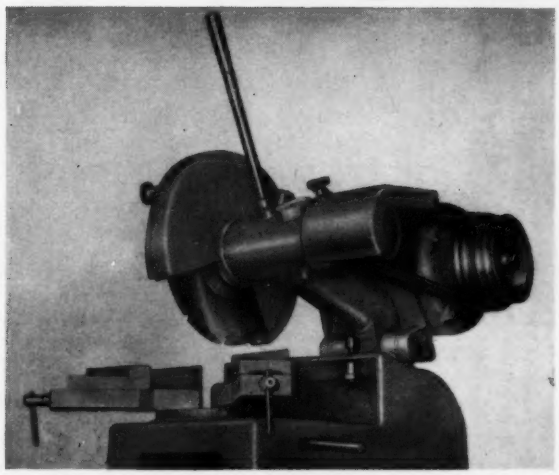




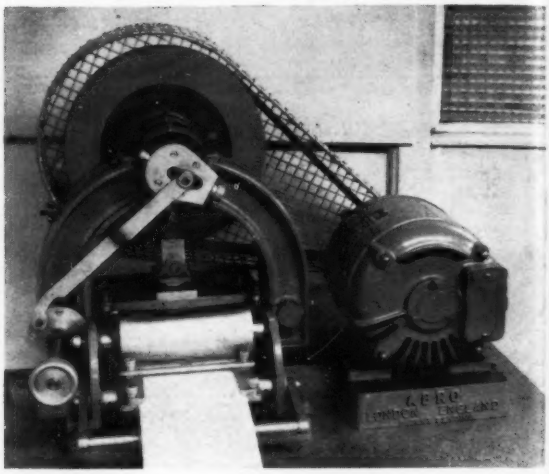
Left : The Roto-Finish DW 16/16/2 barrelling machine

Right : The Newton-Victor "Maxilume" radiograph viewer

Below : The Rapto B1 abrasive and friction cutting machine



The Tektor Major level control, showing the case open and the chassis removed



The Abro 2½ ton motorized power press with automatic roller feed

glareless light of true north daylight character with a complete absence of flicker. These are fitted in an efficient reflector with a special plastics diffuser panel of high light transmission characteristics.

The illuminators are supplied wired, complete with two 15 watt, 18 in. fluorescent lamps and lampholders, auxiliary control gear, rotary switches, and 6 ft. of mains cable, for operation from 200-250 V, 40-60 c/s A.C. They are suitable for radiographs up to 14 in × 17 in.

The film to be examined is held in position by means of a ball type film holder mounted in a clear Perspex bar which enables the very top edge of the film to be seen and ensures easy trouble-free insertion, together with firm retention of the negative without scratching or marking.

As very little heat is given off by the fluorescent lamps, units may be safely recessed without special ventilation.

When heavier densities up to 2·5 are to be examined, the illuminator can be fitted internally with a high-intensity photoflood lamp, so arranged that the fluorescent tubes are switched off when the photoflood lamp is used.

A dimming device can also be supplied, in which case an extra control switch is provided on the front panel.

The dimming device provides a means of regulating light intensity from full down to 15 per cent of maximum. The rotary control on the front of the illuminator, next to the on/off mains switch, reduces intensity to 75 per cent and 60 per cent in two steps, and then continuously to 15 per cent. The illumination from the viewing panel remains uniform, with complete absence of irritating flicker, and "instant starting" is possible at the reduced intensities.

To avoid risk of damaging the wet film by accidental contact with the illuminator, and to prevent water entering the illuminator itself, a one-piece plastics panel can be supplied with the lower end of the panel moulded to form a channel to catch drips from the wet films. The panel is quickly slipped over two chromium-plated supports fitted to the upper part of the illuminator. These same supports carry the film hanger so that the film is held clear of the illuminator panel.

By reducing the illuminated area and eliminating the extraneous marginal light, smaller radiographs or particular portions of large radiographs can be viewed, and fine detail examined critically without eyestrain.

Level Control

OFFERING improved sensitivity and greater general performance than the existing range of level controllers, a new Tektor Major has been introduced by Fielden Electronics Limited, Wythenshawe, Manchester. Although basically this instrument operates on the capacity method, it cannot be over-emphasized that it is not merely another form of proximity switch — it has been engineered as a stable, reliable level controller. Designed for a multiplicity of level control problems, it can easily be installed and will work consistently and accurately with virtually no attention.

The following features are incorporated: a control knob situated inside the case on the front of the chassis enables the set-point to be easily adjusted on site. Once adjusted, a note may be taken of the reading for future reference. The chassis can be removed quickly and easily by a simple quarter turn on the holding screws. This greatly facilitates servicing, especially when the unit is situated in an inaccessible position.

The sensitivity of the Major is better than 1 pF under all conditions. Negligible effects ensue from: (a) a ±10 per cent change in supply volts, (b) an ambient temperature change of from −20°C. to 50°C., or (c) a lapse of time. In the case of the control point the zero drift as a result of these conditions is:—(a) not more than ±1 pF; (b) not more than 2 pF (referred to 20°C.), and (c) not more than ±1·5 pF.

The relay is of the contactor type, guaranteed switching capacity 440 V 5 amp. A.C. non-inductive. One pair normally open contacts, one pair normally closed. Contacts are easily replaceable.

For the high level model, standard lengths of cable are 6, 12, 20, 30, with 35 ft. maximum, and for the low level model 6, 12 and 20 ft. A cable selector switch is fitted, enabling the appropriate cable length to be accommodated on site. The performance of the instrument is independent of cable length up to the stated maximum.

A voltage selector switch is fitted, enabling the instrument to be set, on site, for any supply in the 110-125, 220-250 and 380-440 V ranges, 40-60 c/s.

Power Presswork

A RECENT addition to the range of presses manufactured by Abro (Precision Engineers) Ltd., 591-5 Kingston Road, Raynes Park, London, S.W.20, is a 2½ ton motorized power press with an automatic roller feed. Suitable for blanking, piercing, clipping, embossing, guillotining and similar operations, the press handles strip up to 5 in. wide, and the length of feed can be adjusted from 0 in. to 3 in., infinitely variable. The standard fixed stroke is ½ in., and a ram adjustment is ⅝ in. into the tool. The bed size is 8½ in. by 4½ in., with the hole in the bed measuring 5 in. by 2½ in. The unit is driven by a ½ h.p. motor, the normal speed being 180 r.p.m. Dimensions are 21 in. wide, 17 in. front to back, and 18 in. high. The weight is approximately 180 lb.

RESEARCH AND DEVELOPMENT AT WILLIAM JESSOP AND SONS LTD.

Vacuum Melted Metals

IN addition to the manufacture and marketing of steel, Wm. Jessop and Sons Ltd., of Sheffield, have in recent years concentrated on a number of other special metals to particular requirements. With such a programme, extensive research facilities are needed and some 190 physicists, metallurgists, chemists, engineers and other technologists are employed in the company's research laboratories.

Three items of special importance at present are the "Vacumelt" process of vacuum melting, developed by Jessop, the manufacture of titanium and its alloys, and the manufacture of zirconium.

Titanium production plant was laid down in 1954 as a private venture by Jessops, the plant being designed and built by the firm's engineers.

Zirconium is another of the newer metals produced by the vacuum-melting technique, and it is now required in quantity for the nuclear power programme.

Research Department

The present research department had its beginnings in the early 1930s, when the existing works control analytical laboratory extended its activities to include some investigational work. In the early days development was slow, but there was a rapid increase in the size of the department when the firm entered the field of high-temperature steels and alloys. In 1950, Whiston Grange, near Rotherham, was adapted as a research laboratory for long-term investigational and development work, and 50 members of the research team are housed there.

With the development of heat-resisting materials there has been a continually increasing demand for creep testing facilities, and now Jessops have in constant use over 200 creep units.

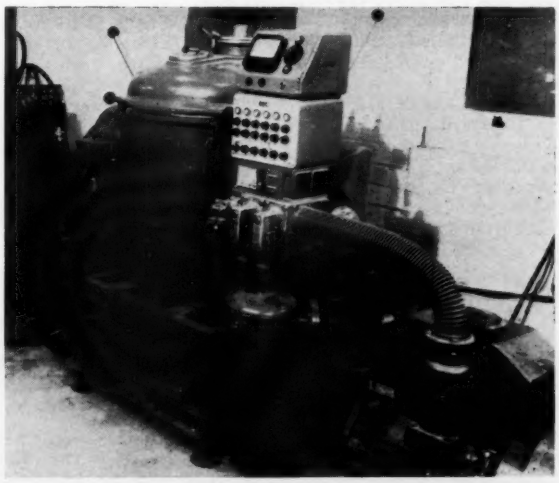
The research staff represents approximately 6 per cent of the total employees of the company. This is rather a high figure compared with most other special steel manufacturers, but with the wide range of products in steels, high-temperature alloys and special metals such as titanium and zirconium, research development and control must play a large part in the company's activities.

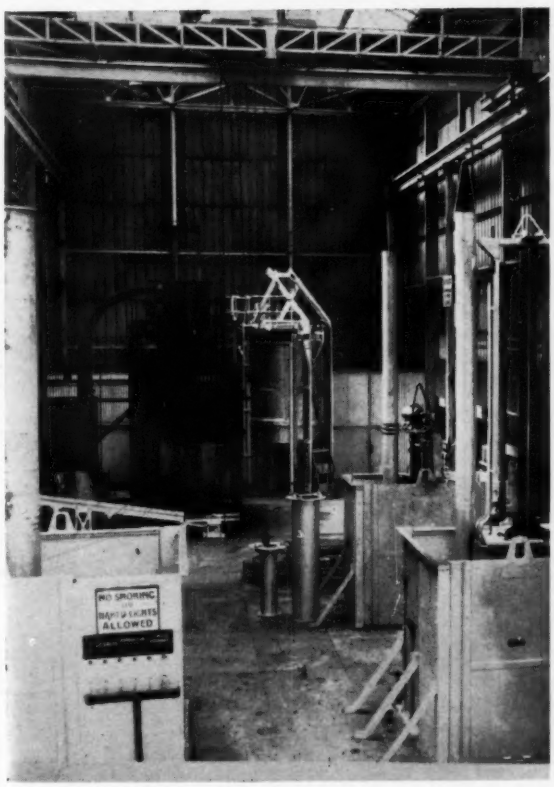
The methods adopted by Jessops for vacuum melting are (1) the consumable arc melting process, whereby air-melted material is used as an electrode and remelted under vacuum. By this method they are able now to produce ingots weighing 30 cwt.

Right: 20-lb. vacuum induction melting furnace

Bottom right: Ultrasonic inspection of large titanium slab

Bottom left: A general view of the titanium melting plant





(steel), and with the new plant being installed will be able to produce ingots up to 3 tons in weight. (2) The high-frequency induction process whereby the complete melting from raw materials and the subsequent casting of the ingot is carried out in an evacuated chamber.

Titanium

Titanium must be melted in the absence of air, as the liquid metal is so reactive that it quickly forms a solidifying mass of titanium oxide. Even with quite small quantities of air present, enough oxygen may be dissolved to make the resulting metal hard and brittle. The company adopts a double melting technique, using an ingot from the first melting as an electrode for the second melting, thus ensuring a completely homogeneous alloy with the minimum impurities present, e.g. the total hydrogen and nitrogen content of a typical melt would be only 160-170 p.p.m.

Seven brands of titanium and titanium alloys are now being marketed under the trade name of "Hylite."

Zirconium

Zirconium production is akin to that of titanium in that the metal has a great affinity for oxygen and nitrogen and, therefore, the melting process must be carried out under vacuum.

Zirconium, with a specific gravity of 6·5, has its main application in atomic energy applications. Zirconium and zirconium alloys have good corrosion resistance and low neutron absorption value, and hence can be used to advantage within the region of the atomic reactor.

Heat-Treatment of Light Alloy Castings

FOR the annealing, solution heat-treatment and ageing of aluminium alloy castings, a forced-air circulation furnace has recently been installed at Cambrian Castings Ltd., of Hirwaun, Aberdare, by Royce Electric Furnaces Ltd., of Walton-on-Thames, Surrey.

The furnace is one of the standard range of VFC type furnaces produced by Royce Electric Furnaces Ltd. in sizes from 10 in. diameter × 10 in. deep to 36 in. diameter × 60 in. deep; it may be used for tempering, preheating or similar heat-treatment at temperatures up to 750°C.

To achieve the close control and uniformity, high velocity air circulation is passed over the heating elements housed in a baffled annulus surrounding the work chamber, the heated air passing through the charge on return. Heat is, therefore, transferred to the charge by forced convection, giving a uniform and rapid heating cycle.

Heating elements are of 80:20 nickel chromium, suspended directly in the air stream and shielded from the work chamber to eliminate direct radiation. Air circulation is produced by a heat-resisting steel, high velocity centrifugal fan unit mounted in the base of the furnace. The air impeller is specially designed to displace, under all temperature conditions, the maximum volume of air with widely varying conditions of pressure which may be imposed by different types of charge and density of loading. An air-cooled motor with a heat-resisting steel extended spindle gives a trouble-free performance for the combined duty of high speed and elevated temperature.

Charge baskets are provided and heat-resisting castings are fitted in the base of the furnace chamber to support heavy loads.

The lid is easily operated by hand by a lever-linking mechanism which locks the lid in the raised position for moving to one side. A back-post pivot fitted with ball race bearings makes this a rapid and simple operation and, therefore, very suitable for solution heat-treatment.

To meet A.I.D. requirements, the control gear includes an Electroflo automatic indicating controller and three-point recording instrument.

The Royce heat-treatment furnace for light alloy castings

Research Progress

—continued from page 88

the average strain near transverse grain boundaries or in the centre of grains could be detected, the strains in both regions being equal to the strain measured on the specimen as a whole.

Another result, difficult to explain using the Nabarro-Herring ideas but conforming with a dislocation-activated mechanism, was obtained by an experiment in which a specimen was tested at 920°K. and a stress of 7 lb/in^2 until a strain of 0·00096 had occurred. The load was removed, the specimen held at temperature for 23·5 hr. and then reloaded. It was found that the subsequent creep was initially of the transient type, indicating that some form of recovery had occurred when the stress had been removed. The decreasing rate of creep observed in the transient stage is itself not easy to explain using a vacancy transport theory, though it can be understood readily if the dislocation model is used.

Harper and Dorn consider, with some justification, that these and other observations make it impossible to accept the Nabarro-Herring mechanism even for the very low stress range in the high temperature creep of aluminium. It is equally clear, however, that the Weertman theory breaks down at the lowest stresses, and, indeed, although Harper and Dorn conclude, by inference, that a dislocation-climb mechanism is responsible for the high temperature creep of aluminium, they do not give any indication of the reason why, if their conclusion is valid, a threshold or critical stress for creep does not exist, in conformity with the critical stresses usually found in processes occurring by dislocation mechanisms.

References

1 J. Harper and J. E. Dorn; *Acta Metallurgica*, 1957, **5** (11), 654.

2 C. Herring; *J. Appl. Phys.*, 1950, **21**, 437.

3 J. Weertman; *J. Appl. Phys.*, 1955, **26**, 1213.

Industrial News *Home and Overseas*

Precision Tube Drawing

In a one-storey factory building in Lea Valley Road, Ponders End, Middlesex, the recently-formed company of **Enfield Tubular Products Limited** is now in full production of non-ferrous tube and tubular components, having completed its first stages of plant installation. The factory is equipped with modern draw benches for plug and mandrel drawing thin-walled tubes from $\frac{1}{32}$ in. up to 1 in. diameter, and with wall thicknesses generally below 18 s.w.g. down as thin as 0·004 in. These sizes can be supplied in a wide variety of metals, including aluminium, aluminium alloys, brass, copper, copper nickel alloys, gilding metal and phosphor bronze, in random lengths or in processed pieces.

Among industries catered for by the company are the scientific instrument, motor car, aircraft and refrigeration industries, and it is intended to so expand production as to cover other industries. Impact extrusion for close tolerance components is also a development which is being considered by the company, and it is understood that experimental work in this direction is already being done.

A Removal

It is announced by **New Metals and Chemicals Ltd.** that they have removed from Northumberland Avenue, London, to larger premises at Chancery House, Chancery Lane, London, W.C.2. The telephone number is now Holborn 7415 (8 lines).

Office Extensions

Work is in progress on a 5,000 ft² extension to **Electro-Chemical Engineering Company Ltd.'s** offices at Sheerwater, near Woking. Completion is scheduled for May, the additional space being required for an expansion of the firm's engineering department and to accommodate a new accounts and costing department, and a room where technical films may be shown.

The main contractors are Hills (West Bromwich) Ltd., and construction comprises their modular "Presweld" system, using a galvanized steel frame and prefabricated facing slabs. This has the advantages of speedier construction, lower initial cost and a more contemporary appearance, in addition to providing excellent working facilities. This extension is being built only 18 months after the company's move to Sheerwater and reflects the considerable increase in the sale of Efco-Udylite automatic machines and processes during that period.

An external view of the new extension to the office block of the Electro-Chemical Engineering Company Limited at Sheerwater

Trading in Australia

A new associate manufacturing company is to be established during this present year in Sydney, Australia, by **Foundry Services International Limited,** one of the companies within the Foseco group which is concerned, principally, with the manufacture and supply of chemical and metallurgical preparations for the treatment and improvement of metals. Foseco also announces its intention to commence manufacture in India in the very near future.

Sole Distributors

It is announced that **Sir W. H. Bailey and Company Limited** have been appointed sole distributors for the flow indicating equipment produced by the Dukes and Briggs Engineering Company. This equipment at present comprises their "Telicator" visual flow indicators, although other models are shortly going into full-scale production which will provide a full range of flow indicators to cover all requirements.

These "Telicator" flow indicators are stated to have applications in all branches of industry, including forced lubrication systems and water supplies for cooling purposes. Apart from the standard range for single- or multi-circuit indications, designs can be produced for individual requirements, while a special model is available for use with opaque liquids.

Plastics-coated Steel

Some months ago we were able to refer to a new British material called "Stelvetite," a plastics-coated steel sheet, which was produced by **John Summers and Sons Ltd.** in conjunction with B.X. Plastics Ltd. Further details relating to this product have recently been released.

The most remarkable feature of this new product is that it can be worked and treated as ordinary steel sheet, while its outer surface retains all the characteristics of P.V.C. plastics, produced in a varied range of colours and embossed patterns. The outer plastics surface is said to be a permanent, complete finish in itself, being extremely easy to clean and maintain.

Stelvetite is available in steel gauges from 26 G. (0·0196 in.) to 16 G. (0·0625 in.) and in sheet lengths and widths of up to 144 in. and 48 in. respectively. The P.V.C. coating is 0·014 in. thick. It can be supplied in almost any colour, in any of the range of embossings.

Sunvic P.H.A. School

A series of one-week courses on the use of pulse height analysers is being given by **Sunvic Controls Limited** at Harlow. The principal object is to provide a detailed knowledge of the circuitry and functioning of the analyser, and special emphasis is laid on servicing and fault-finding aspects; normal routine setting up and operating procedure are also covered. In addition, a study of the instrument's uses in nuclear physics research and radiation spectroscopy is included.

Instruction is divided into six parts and practical work on the instrument is included in each phase. Three of these courses have so far been completed. Students have comprised representatives of both scientific and industrial research establishments, including several outside the United Kingdom. At present the company makes only a nominal charge towards the cost of accommodation during the students' stay in Harlow.

Z.A.D.C.A. Open Day

An open day for the benefit of engineers, designers, die-casters and others interested in the pressure die-casting process was held by the **Zinc Alloy Die-Casters' Association** at its headquarters in London on Thursday of last week. The main purpose of the function was to provide an opportunity for visitors to discuss and gain further information about the recently-issued "Engineering Standards for Pressure Die-Casting."

Members of the technical committee of the association were in attendance to answer questions, and throughout the day they were kept busy by a steady stream of visitors. Several showings of the film "Die-Casting—How Else Would You Make It?" were organized, and an exhibiton of pressure die-castings also aroused considerable interest.

News from Birmingham

Although unemployment in the Midlands has risen by about 4,000 in the past month, this increase has been spread over various industries and is not regarded with any special significance. It is a normal trend at this season of the year. Short-time working is less and only 265 are now on short time in the motor trade. At a recent meeting of the Midland Regional Board for Industry it was stated that more sites for industry were approved for the West Midlands in 1957 than for any other part of the country. The 388 projects, totalling some

10,500,000 ft², which were approved represented an increase of 14 per cent on 1956. Some of them referred to modernization projects. As nationally there has been a decrease of 10 per cent, this illustrates the confidence of Midland industrialists in the future.

Overtime working is taking place in the steel sheet mills to meet the needs of the motor trade. Output of constructional steel is also in strong demand for delivery against existing building contracts, although there has been a drop in the number of new structural contracts available. Stocks of billets are larger because the re-rolling mills are not operating to capacity. Similarly, the amount of pig iron coming from the furnaces is more than sufficient to cover the needs of light castings makers because of the lack of orders. On the other hand, there is a strong market for castings for the engineering industries, particularly for the motor trade. Heavy steel plates are still in short supply.

European Common Market

We are informed that the **Birmingham Exchange and Engineering Centre,** at Stephenson Place, Birmingham, have arranged an address by Mr. M. H. Fisher, a member of the Foreign Department of the *Financial Times*, to be given at the Centre on Friday, February 7 next, at 7 p.m. The subject of the address is "The European Common Market and Free Trade Area."

Patents Rules

Amended rules making minor changes in the arrangements governing patents applications and fees have been laid before Parliament by the Board of Trade. They include the introduction of a new service to the public by which information will be supplied as to whether any particular patent is in force on payment of a nominal fee of 1s. 0d. for the first patent and 6d. for each succeeding one. This service will replace, and will, it is hoped, be an improvement on, the former annual publication of the "List of Patents in Force."

The new rules are the Patents Rules, 1958 (S.I. 1958 No. 73). They are made under the Patents Act 1949 and 1957, and consolidate and replace the Patents Rules, 1949 (S.I. 1949/2385); the Patents (Amendment) Rules, 1955 (S.I. 1955/117); and the Patents (Amendment) Rules, 1957 (S.I. 1957/618). They come into operation on February 1, 1958, and can be obtained from H.M.S.O. and branches, price 2s. 6d., by post 2s. 10d.

Copper Consumption in U.S.

Actual consumption of refined copper in the United States in 1957, based on shipments of fabricated products, was the smallest for any year since 1954, according to the latest fabricator statistics. At 1,279,181 tons, it was about nine per cent below the 1956 total of 1,416,278 tons. Domestic fabricators consumed 83,162 tons of refined copper in December, as compared with 98,709 tons in the preceding month. Only in the holiday month of July was consumption in 1957 less, the total for that month being 77,991 tons.

The volume of new business that fabricators booked in December in terms of refined copper to be used was 87,726 tons, a decrease of 1,282 tons from November and also the smallest for any month since last July. For all of 1957, the volume of business booked by brass and wire mills and by foundries in terms of refined copper came to 1,228,630 tons, as against 1,306,848 tons in 1956. Unfilled orders on fabricators' books increased by 4,564 tons to 133,283 tons at the end of December.

On December 31, fabricators carried 430,241 tons of refined copper in reserve and had on order 75,627 tons with producers and custom smelters, so that their gross reserve was 505,868 tons. Included in this reserve were 347,465 tons of working stocks, so that their net reserve was 158,403 tons. However, since their unfilled orders call only for the use of 133,283 tons, they actually had a surplus of 25,120 tons.

Change of Address

In the issue of this journal for January 17 (page 54) details of the removal from their old premises at Stanmore, Middx., of the **Brookside Metal Company Ltd.** to their new headquarters at Watford were given. Unfortunately, the advertising announcement of this company in last week's issue of METAL INDUSTRY carried the old address.

It is, therefore, confirmed that the official address of the company is now as follows: Watford Foundry, By-Pass Road, Watford, Herts., with the telephone number of Watford 6474 (10 lines). The company's Telex number is London 28457.

New London Office

From to-morrow (February 1), the London office and warehouse of **John Allan and Company (Glenpark) Ltd.,** a member of the Metal Industries group, will be at Thomas Road, Poplar, E.14, with the telephone number of East 5411.

Long Service Awards

Seventy-seven members of the office and works staff of **G. A. Harvey and Company (London) Ltd.** received long service awards at a ceremony in the works institute of the company, from Mrs. Sydney Harvey, wife of the President of the company. The recipients, who were presented with watches, suitably engraved, included 41 members of the works staff, 4 chargehands, 13 foremen and 19 of the office staff, all of whom have completed over 35 years of continuous service with the company. This represents almost 4 per cent of the total number of employees, and the aggregate service of the recipients totalled 3,067 years.

Tin Council Meeting

At its meeting in London last week the International Tin Council took four major decisions. It extended the period of export control by 17 days but kept the total export amount steady at 27,000 tons; it agreed to a further period of export control lasting to June 30; it extended until June 30 the authority enabling the Buffer Stock Manager to sell tin when the price reaches £781; and it noted the decision of the producing countries to recommend to their Governments consideration of a special fund to be put at the disposal of the Buffer Stock Manager.

In a press communique issued after the meeting, the Council confirmed that the third and final contribution to the Buffer Stock of 5,000 tons from the producing countries had been called up on December 30. Most of this contribution had already been paid in cash in advance of the new date.

The first export control period will end on March 31 instead of its previous date of March 14. "In view of the supply and demand position, the Council decided that the total permissible export amount for the extended period should remain at 27,000 tons," says the communique. This means that the same amount can be exported in the longer period, and represents an overall reduction of about 40 per cent from the producing countries instead of the 28½ per cent allowed so far.

It was decided that the export control shall be carried on from April 1 until June 30 inclusive. The total permissible export amount for the six producing countries in the second period was fixed at 23,000 tons.

"The Council extended until the end of the second control period the authority which enables the Buffer Stock Manager, for instance, to sell tin when the price reaches £781," the communique goes on. "The Council noted that the delegates of the participating producing countries had unanimously agreed to recommend their governments to consider the creation of a special fund to be put at the disposal of the Buffer Stock Manager." Representatives of six producing and 14 consuming countries were present at the meeting.

Belgian Production

Statistics issued in Brussels show that Belgian production of non-ferrous metals last year was generally lower than in 1956, according to provisional estimates. Trade quarters put crude copper production at about 155,000 tons, against 169,000 in 1956; crude zinc at 235,000 (a post-war record) against 231,000; crude lead 100,000 against 102,000, and semi-finished aluminium at 30,800 against 28,700.

Crude copper exports were reported at 120,000 tons, against 136,000 in 1956, while copper semis exports were put at 35,000 tons, against 42,000.

Exports of crude zinc are reported to be about the same for both years at 145,000, while semi-finished zinc exports are estimated at 20,000 tons—some 2,000 higher than in 1956.

Exports of crude lead are estimated at 57,000 tons, against 74,000 in 1956, while exports of semi-finished lead are reported to be close to 4,000 tons, against 4,500 tons in 1956.

Exports of semi-finished aluminium are said to be some 35,000 tons, against 42,000 in 1956.

Fifty Years' Service

An interesting event took place on Friday of last week when two employees of **Cuxson, Gerrard and Co. Ltd.** were each presented with a clock on having completed fifty years' service with the company. The two employees were Miss E. R. Harrold and Mr. J. Heath. A surprise gift was made to Mr. Douglas Gerrard, managing director of the company, who had recently celebrated his 70th birthday.

Aluminium Brazing Plant

A new aluminium dip brazing plant has recently been installed in the London works of **Delaney Gallay Ltd.** This plant is described as one of the most modern in the country.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week totalled 15,634 tons, comprising London 5,164, Liverpool 9,650 and Hull 820 tons. Copper stocks totalled 19,805 tons, and comprised London 11,272, Liverpool 6,608, Birmingham 1,225, Manchester 25, Swansea 425 and Hull 250 tons.

A general view of the company at the inauguration of the new "20 Club" of W. Canning and Co. Ltd., last week.

A New Club

Under this heading in last week's issue of this journal (page 77), details were given of the new "20 Club" formed by W. Canning and Co. Ltd., and inaugurated at a dinner given in the works canteen at Birmingham, and presided over by **Sir Ernest Canning,** chairman of the company, who was at the same time elected President of the new club.

An interesting sidelight on this function was the fact that **Mr. S. S. Dawson,** sales director of the company, who is also chairman of the committee of the new club, was, almost 50 years ago, present at the inauguration of the Magnet Club, Witton, Birmingham, and was its first secretary from 1908 to 1912. Our photograph on this page gives a view of the general gathering last week.

A Birmingham Meeting

On Thursday of next week (February 6) the **Birmingham Metallurgical Society** will hold its next meeting at the Byng Kendrick Suite, The College of Technology, Birmingham, at 6.30 p.m., when a Paper will be presented by Mr. J. E. Elliot on "Porous and Infiltrated Metals." The chair will be taken by Mr. R. Chadwick, President of the Society.

British Foundrymen

Members of the Slough section of the **Institute of British Foundrymen** will meet in the Lecture Theatre of High Duty Alloys Ltd., at Slough, on Tuesday, February 11 next, to hear a Paper on "Feeding Aids to Castings" by Mr. A. L. Hogan, of the Harborough Construction Company Ltd. The meeting will commence at 7.30 p.m.

Chilean Copper and Russia

Chile has rejected a proposal to export copper to Russia and other Soviet bloc nations, the Foreign Ministry announces. The possibility of such sales had been discounted, it said. Information received by the Ministry from representatives of local industry and commerce revealed that there "was no interest in either the products or currency of these countries."

Combating Rust

On Monday last, in London, **Associated Lead Manufacturers Ltd.** exhibited for the first time the new colour film which had been produced featuring "Rustodian," the rust-inhibiting calcium plumbate paint. This film shows some of the exposure tests to which "Rustodian" was subjected, and the film makes a flashback to 1941—and the discovery of the rust-inhibiting properties of calcium plumbate. The initial experiments are reconstructed and the film then shows the encouraging results which these produced. Further tests made by researchers developing the pigment and the paint are also described.

The film then shows how calcium plumbate pigment was thoroughly evaluated and how Associated Lead—who had sponsored the research—put it into commercial production and marketed it under the trade name of "Caldiox." Then is shown the manufacture of Rustodian using "Caldiox" pigment, and emphasis is laid on the remarkable qualities of adhesion of Rustodian, which have made it an excellent primer for most metals and for new, unetched galvanizing. A series of shots illustrate that this is a primer with almost universal application.

Finally, the film depicts some of the successes which this primer is now having in connection with new buildings, and also for marine work. The running time for this film is 22 min. and it has been produced in 16 mm. Eastmancolor.

Aluminium in Japan

From Tokyo, a Japanese trading firm reports that Japanese aluminium refineries have received enquiries from Australia and the United States for imports of large amounts of primary aluminium, but that their bid prices are much lower than present Japanese price ideas. A spokesman for the Sumitomo Shoji Trading Company said Australia had offered to buy several hundred tons of aluminium ingots at a price below 24.63 United States cents per lb., c. and f. Australia, which is now applied to Australian imports of aluminium from Canada. He added American consumers also wanted to import 2,000 tons of aluminium ingots from Japan at 23 cents per lb., c.i.f. American ports, compared with the domestic price of 26 cents for American refineries' products.

The spokesman added that the Japanese refineries were maintaining the "check price" of 515 United States dollars per ton, f.o.b. Japan, for exports. The Ministry has authorized the exports of a total of 610 tons of aluminium ingots since last October, when exports were resumed. Local trade sources said nearly 1,000 tons had already been sold to South America and South-East Asian countries, as well as China, out of the export target of 2,000 tons.

Forthcoming Meetings

February 4 — Incorporated Plant Engineers. Edinburgh Branch. 25 Charlotte Square, Edinburgh. "Testing of Engineering Materials, Destructive and Non-Destructive, by Mechanical, Chemical, X-ray and Ultrasonic Means." J. A. Menzies. 7 p.m.

February 4—Institute of Metals. Oxford Local Section. Cadena Café, Cornmarket Street, Oxford. "Technical Control of Some Metalworking Processes." A. R. E. Singer. 7 p.m.

February 4—Institute of Metals. South Wales Local Section. Department of Metallurgy, University College, Singleton Park, Swansea. "Secondary Metal Recovery." H. J. Miller. 6.30 p.m.

February 4—Institute of Metal Finishing. Midland Branch. James Watt Memorial Institute, Great Charles Street, Birmingham, 3. "Some Considerations in the Theory and Practice of Alloy Plating." J. W. Cuthbertson. 6.30 p.m.

February 4—Institute of Metal Finishing. Scottish Branch. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow. Film on "Electrostatic Spraying." R. Tilney. 7.30 p.m.

February 5 — Institution of Production Engineers. Nottingham Section. Victoria Station Hotel, Nottingham. "Metallurgy in Production." H. D. Ward. 7 p.m.

February 5—Incorporated Plant Engineers. Leicester Branch. The Bell Hotel, Leicester. "Trade Waste Effluents." S. J. Roberts 7 p.m.

February 6—Institute of Metals. Birmingham Local Section. College of Technology, Gosta Green, Birmingham, 4. "Porous and Infiltrated Metals." J. E. Elliott. 6.30 p.m.

February 6—Institute of Metals. London Local Section. 17 Belgrave Square, London, S.W.1. "Corrosion by Liquid Metals." B. R. T. Frost. 6.30 p.m.

February 6—Institute of Metal Finishing. North West Branch. Engineers' Club, Albert Square, Manchester. "Barrel Enamelling." W. S. Field. "Centrifugal Lacquering." J. G. Lemon. 7.30 p.m.

Metal Market News

LAST week was a disastrous one for holders of copper, for the price collapsed to the extent of more than £10, and at the close there were sellers of cash at £161 and of three months at £163 5s. 0d., the contango narrowing to £2 5s. 0d. The turnover, including Kerb dealings, probably exceeded 9,000 tons but of this some, at any rate, was represented by carries. The actual losses recorded were £10 15s. 0d. for cash and £11 10s. 0d. for three months. At the beginning of the week stocks in L.M.E. warehouses were reported 250 tons down at 19,654 tons, but neither this nor the cut of 9 per cent in Arizona by Phelps Dodge did anything towards checking the fall, which only seemed to gather strength as it went on. Adverse factors during the week were a cut of 50 points in the custom smelters quotation to 24 cents and a lowering of the Belgian price by 1·25 francs to 23·75 francs per kilo. In the United States the value of copper scrap declined to 17¾ cents, or even lower, and at the end of the week it was freely predicted that a further fall in the prices of both producers and custom smelters would be seen before long. The outlook is obscure and the prospect of any check to the downswing, let alone an upward turn, is, it must be admitted, pretty poor. Wall Street sessions have been for the most part extremely disappointing, and new low levels for this year's trading are seen week by week. No doubt the situation in the United States is very poor and the outlook unsatisfactory.

The tin market presented a much more cheerful appearance last week, and on balance cash was up £2 10s. 0d. and three months by no less than £18, of which half was gained on Friday last. An increase of only 114 tons in L.M.E. stocks, to 14,909 tons, at the beginning of the week induced a better tone, and with the Eastern market improving sentiment strengthened in London. At the end of trading on Friday afternoon cash stood at £733 sellers, while three months was quoted at £723. The press notice by the Tin Council was not issued until after the market had closed, but it has, of course, put a different complexion on things, and the market has not been slow to respond. After all, the action contemplated is fairly drastic. The initial export control period, which was originally to end on March 14, has been extended to the end of the month. The total of permitted exports, however, has not been raised, from which it would seem that the reduction in exports will, in fact, go up from 28½ per cent to 40 per cent. Again, export control is to be extended for a further three months to June 30 and during those three months exports will be limited to 23,000 tons. Finally, and this is obviously of considerable importance, it has been agreed to recommend to the Governments concerned that a special fund should be created which would be made available for the Buffer Stock manager.

The decision to stockpile Australian zinc concentrates rather than rail them to the coast for shipment put the zinc market up a couple of pounds, but the market lost some of the gain and closed 25s. up for January and £1 better for April on balance. The turnover was about 4,500 tons. Nothing fresh is reported from the States on the zinc tariff-situation, and stocks are everywhere very ample. In lead, some 2,875 tons changed hands, January closing 5s. up at £71 15s. 0d. while April gained 17s. 6d. at £72 10s. 0d. The contango, therefore, widened to 15s. Both lead and zinc are now showing a steadier front, but the outlook is not very bright for them.

South Wales

Industries in South Wales are taking stock of the position and can foresee some difficulties ahead. The closing down of redundant hand mills in the West Wales district occurred somewhat sooner than expected, due to a decline in demand for tinplates. However, despite the dislocation of local labour, the modern plants at Velindre and Troste associated with the gigantic steel undertaking of The Steel Company of Wales Ltd. should cushion the impact of these closures.

Foundries — Some slackness is reported in those foundries associated with shipping, due to the continued lay-up of surplus tramp shipping tonnage. However, most firms report a fair volume of orders for small castings but state that there are not many heavy castings on order. Local refineries—copper, nickel, zinc, and aluminium are well employed.

Scrap metals—There is a limited but sustained demand for heavy copper scrap and good gunmetal. Aluminium scrap of all grades shows a marked advance in price.

New York

The non-ferrous metal market continued depressed during the last week with consumer interest meagre. In copper, the custom smelter price of 24½ cents per lb. was considered shaky and some sources indicated that buying interest below 24½ cents would be readily met. Producer copper continued quiet. Phelps Dodge announced a further cutback of 9 per cent in copper output which, trade sources estimated, would mean about 1,700 tons a month. These sources estimated that production cuts at U.S. copper mines announced so far aggregated almost 14,500 tons a month, including the latest Phelps Dodge and Kennecott cutbacks. Foreign mine cutbacks or shutdowns were estimated by these sources at roughly 10,300 tons, of which 5,800 tons represented current reductions in the Belgian Congo and Chile.

Lead and zinc were moving, at best, modestly. One leading seller said one or two large factors did some fair buying during the period, but the general tone was depressed. The influx of foreign lead and zinc was increasing because of the wide price disparity between London and the U.S., as well as the inclination of foreign shippers to move their metal to the U.S. before the Tariff Commission made its recommendations on the lead-zinc industry request for higher tariffs.

Lead and zinc trade sources reported that there had been some revived interest in barter deals. The tonnage involved was small, because of the strict regulations surrounding the barter. These sources estimated the amount involved at about 4,000 tons; 3,000 tons of lead and 1,000 tons of zinc, broken up into a dozen transactions.

The tin market was easy early in the week, reflecting a decline abroad and fears that the Tin Council's stabilization efforts might be faltering. However, the market rallied latterly as Buffer Pool buying support again asserted itself. Traders said business transacted was at a minimum with consumer interest negligible.

The Tariff Commission has outlined the contents of the eight proposed schedules of imports it is in the process of compiling. The eight new schedules and one covering temporary tariff measures would reclassify and replace the 15 tariff schedules now being used to compute import duties.

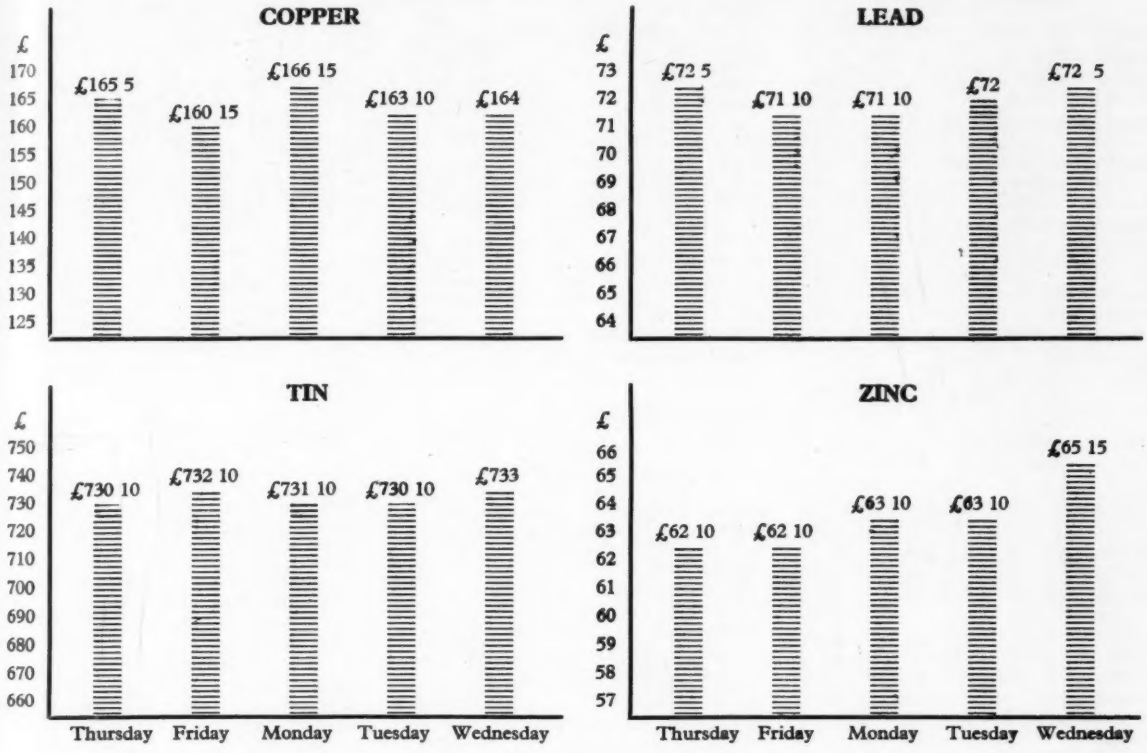
Of interest in non-ferrous metals is—Schedule 5: Includes "other metallic minerals and products." Schedule 6: Ores, concentrates, flue dust, mattes and speiss, iron and steel and their alloys in scrap and basic shapes and forms, ferro-alloys, non-ferrous metals and their alloys in scrap and basic shapes and forms, metal products other than machinery and electrical apparatus, and machinery and electrical apparatus.

Zurich

The continuing weakness in world non-ferrous metal markets has continued to depress the Swiss market, and buying interest in the last few weeks has been small. Although Swiss consumption of non-ferrous metals is still running at comparatively high levels, manufacturers are showing extreme caution in their operations and, in the belief that a price upturn can be ruled out for the time being, are running down their stocks. Those who have reduced their stocks to a considerable extent are purchasing only to cover day-to-day requirements.

METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 23 January 1958 to Wednesday 29 January 1958



OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton	Canada c/lb ≏ £/ton	France fr/kg ≏ £/ton	Italy lire/kg ≏ £/ton	Switzerland fr/kg ≏ £/ton	United States c/lb ≏ £/ton
Aluminium		24.63 203 10	198 172 5 0	400 232 0	2.50 209 0	28.10 224 17 6
Antimony 99.0			195 169 12 6	430 249 10		33.00 264 0
Cadmium			1,400 1,218 0	2,800 1,624 0		155.00 1,240 0
Copper						
Crude						
Wire bars 99.9				345 200 8 6		
Electrolytic	23.75 173 12 6	24.75 202 10	223 194 0		2.20 184 0	25.00 200 0
Lead		12.25 101 2 6	123 107 0	183 106 7 6	.92 77 0	13.00 104 0
Magnesium						
Nickel		71.50 590 10	1,060 922 5	1,330 771 10	8.10 677 2 6	74.00 592 0
Tin	102.00 745 12 6		904 786 10	1,400 812 0	8.80 735 17 6	93.50 748 0
Zinc						
Prime western		10.00 82 12 6				10.00 80 0
High grade 99.95		10.60 87 10 0				
High grade 99.99		11.00 90 5				
Thermic			107.12 93 2 6			
Electrolytic			115.12 100 2 6	157 91 0	.85 71 0	11.75 94 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 12 noon 29/1/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	197	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		10	0
Calcium	„	2	0	0
Cerium 99%	„	13	18	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite	per unit		—	
Copper H.C. Electro	ton	164	0	0
Fire Refined 99·70%	„	163	0	0
Fire Refined 99·50%	„	162	0	0
Copper Sulphate	„	67	0	0
Germanium	grm.		3	4
Gold	oz.	12	8	8½
Indium	„		10	0
Iridium	„	27	0	0
Lanthanum	grm.		15	0
Lead English	ton	72	5	0
Magnesium Ingots	lb.		2	5½
Notched Bar	„		2	10½
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	300	0	0
Mercury	flask	73	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	7	10	0
Platinum	„	28	10	0
Rhodium	„	40	0	0
Ruthenium	„	16	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	4⅛
Tellurium	lb.		15	0
Tin	ton	730	0	0
Titanium	lb.		19	6
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	63	5	0
Dust 95/97%	„	104	0	0
Dust 98/99%	„	110	0	0
Granulated 99+%	„	88	5	0
Granulated 99·99+%	„	104	12	6

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

†**Aluminium Alloy**		£	s.	d.
B.S. 1490 L.M.1	ton	154	10	0
B.S. 1490 L.M.2	„	158	10	0
B.S. 1490 L.M.4	„	182	0	0
B.S. 1490 L.M.6	„	204	10	0

†Average selling prices for November.

***Aluminium Bronze**				
BSS 1400 AB.1	ton	197	0	0
BSS 1400 AB.2	„	210	0	0
***Brass**				
BSS 1400-B3 65/35	„	128	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„		—	
***Gunmetal**				
R.C.H. 3/4% ton	ton		—	
(85/5/5/5)	„	157	0	0
(86/7/5/2)	„	167	0	0
(88/10/2/1)	„	209	0	0
(88/10/2/½)	„	220	0	0
Manganese Bronze				
BSS 1400 HTB1	„	174	0	0
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„		—	
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
2B8 guaranteed A.I.D. released	„		—	
Phosphor Copper				
10%	„	206	0	0
15%	„	214	0	0

**Average prices for the last week-end.*

Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	345	0	0
Grade D Plumbers	„	279	3	0
Grade M	„	378	0	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
Mazak III	ton	97	17	6
Mazak V	„	101	17	6
Kayem	„	107	17	6
Kayem II	„	113	17	6
Sodium-Zinc	lb.		2	5

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium			£	s.	d.
Sheet 10 S.W.G.	lb.			2	9
Sheet 18 S.W.G.	„			2	11
Sheet 24 S.W.G.	„			3	2
Strip 10 S.W.G.	„			2	9
Strip 18 S.W.G.	„			2	10
Strip 24 S.W.G.	„			2	11½
Circles 22 S.W.G.	„			3	3
Circles 18 S.W.G.	„			3	2
Circles 12 S.W.G.	„			3	1
Plate as rolled	„			2	8½
Sections	„			3	2½
Wire 10 S.W.G.	„			3	0
Tubes 1 in. o.d. 16 S.W.G.	„			4	1
Aluminium Alloys					
BS1470. HS10W.					
Sheet 10 S.W.G.	„			3	1½
Sheet 18 S.W.G.	„			3	4
Sheet 24 S.W.G.	„			3	11½
Strip 10 S.W.G.	„			3	1½
Strip 18 S.W.G.	„			3	3
Strip 24 S.W.G.	„			3	11
BS1477 HP30M.					
Plate as rolled				2	11½

Aluminium Alloys—*cont.*		£	s.	d.
BS1470. HC15WP.				
Sheet 10 S.W.G.	lb.		3	9½
Sheet 18 S.W.G.	„		4	1½
Sheet 24 S.W.G.	„		4	11½
Strip 10 S.W.G.	„		3	10½
Strip 18 S.W.G.	„		4	1½
Strip 24 S.W.G.	„		4	9
BS1477. HPC15WP. Plate heat treated	„		3	6½
BS1475. HG10W. Wire 10 S.W.G.	„		3	10½
BS1471. HT10WP Tubes 1 in. o.d. 16 S.W.G.	„		5	0
BS1476. HE10WP. Sections	„		3	2
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		1	4
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	198	0	0
Extruded Bar	lb.		1	7½
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	137	0	0
Condenser Plate (Naval Brass)	„	147	0	0
Wire	lb.		2	2⅛
Bronze Sheet and Strip	ton		—	
Copper Tubes	lb.		1	7
Sheet	ton	188	0	0
Strip	„	188	0	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	210	15	0
Cupro Nickel Tubes 70/30	lb.		3	1
Lead Pipes (London)	ton	112	5	0
Sheets (London)	„	110	0	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Rods	lb.		—	
Sheet and Strip 7%	„		3	2½
Wire 10%	„		3	9½
Phosphor Bronze Wire	„		3	4⅛
Titanium				
Billet	lb.	4	10	0
Sheet	„	6	12	0
Wire	„	9	10	0
Tube	„	16	0	0
Zinc Sheets, English destinations	ton	97	10	0
Strip	„		nom.	

LATE NEWS

Singapore.—Speaking in Singapore on Tuesday last, Sir Alexander Fleck, chairman of Imperial Chemical Industries Limited, said that business would be more difficult in Britain this year than last. He told the company's employees in Malaya that there were signs the company was meeting more competition.

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 28/1/58.

	£
Aluminium	
New Cuttings	160
Old Rolled	130
Segregated Turnings	97
Brass	
Cuttings	114
Rod Ends	104
Heavy Yellow	88
Light	83
Rolled	104
Collected Scrap	84
Turnings	100
Copper	
Wire	140
Firebox, cut up	140
Heavy	134
Light	129
Cuttings	140
Turnings	123
Braziery	114
Gunmetal	
Gear Wheels	145
Admiralty	145
Commercial	118
Turnings	113
Lead	
Scrap	63
Nickel	
Cuttings	—
Anodes	530
Phosphor Bronze	
Scrap	118
Turnings	113
Zinc	
Remelted	52
Cuttings	43
Old Zinc	29

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£148.0.6)	170
Heavy copper	(£148.0.0)	170
Light copper	(£121.17.6)	140
Heavy brass	(£95.15.0)	110
Light brass	(£62.12.6)	72
Soft lead scrap	(£52.5.0)	60
Zinc scrap	(£34.17.6)	40
Used aluminium unsorted	(£82.12.6)	95
France (francs per kilo):		
Copper	(£195.15.0)	225
Heavy copper	(£195.15.0)	225
Light brass	(£143.10.0)	165
Zinc castings	(£68.15.0)	79
Tin	(£565.10.0)	650
Aluminium pans (98½ per cent)	(£139.5.0)	160
Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£194.7.6)	335
Aluminium copper alloy	(£104.10.0)	180
Lead, soft, first quality	(£88.15.0)	153
Lead, battery plates	(£53.7.6)	92
Copper, first grade	(£162.10.0)	280
Copper, second grade	(£148.0.0)	255
Bronze, first quality machinery	(£168.5.0)	290
Bronze, commercial gunmetal	(£139.5.9)	240
Brass, heavy	(£110.5.0)	190
Brass, light	(£101.10.0)	175
Brass, bar turnings	(£116.0.0)	200
New zinc sheet clippings	(£58.0.0)	100
Old zinc	(£43.10.0)	75

Financial News

Yorkshire Imperial Metals Ltd.

A new company has just been registered under the above title to carry into effect a merger of the Yorkshire Copper Works Ltd. with the undertaking comprising the production, sale and distribution of copper and copper alloy tubes, ferrules, plates and tube fittings, and lead and lead alloy sheet and pipe, and zinc chloride carried on by the Metals Division of Imperial Chemical Industries Limited, by acquiring the whole of the undertaking of said Yorkshire Copper Works Ltd. and the whole aforesaid undertaking carried on by the Metals Division of I.C.I. The directors of the new company are not yet named.

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons, Limited, Company Registration Agents, Chancery Lane, W.C.2.

Nixon and Whittick Limited (594839), 89a Grove Road, Windsor. Registered December 5, 1957. To carry on business of electro, chromium, nickel, silver and metal platers, etc. Nominal capital, £2,000 in £1 shares. Directors: T. J. G. Whittick, G. Nixon, Mrs. S. G. Whittick and Mrs. B. Nixon.

G. and E. Stuart Limited (594891), 80 Ripon Street, Sheffield, 9. Registered December 5, 1957. To carry on business of coal merchants, scrap metal merchants, etc. Nominal capital, £1,000 in £1 shares. Directors: G. Stuart and Emily Stuart.

Jones and Matthews (Bridgend) Ltd. (594983), Morgans Yard, Angel Street, Bridgend. Registered December 6, 1957. To carry on business of scrap merchants, etc. Nominal capital, £200 in £1 shares. Directors: C. Jones and Mrs. N. Matthews.

Rose Chrome Sales Limited (594989), 88-90 Hatton Garden, E.C.1. Registered December 6, 1957. To carry on business of dealers in and agents for the sale of chrome ore, concentrates, metals, etc. Nominal capital, £1,000 in 200 ordinary shares of £1 and 4,000 "A" shares of 4s. each. Directors: I. H. Rosenberg and Anne N. Rosenberg.

William White (Luton) Ltd. (594995), 43a Ridgeway Road, Luton. Registered December 6, 1957. To carry on business of manufacturers and designers of aluminium hat blocks and castings, foundry proprietors, etc. Nominal capital, £100 in £1 shares. Directors: W. White and R. W. Braithwaite.

Trade Publications

Meehanite Castings.—Ashmore, Benson, Pease and Co., Stockton-on-Tees.

An eight-page brochure details and illustrates the many types of Meehanite castings for which this company is responsible. A summary of the physical properties of Meehanite metal is also given.

Polythene Film.—British Visqueen Ltd., Six Hills Way, Stevenage, Herts.

Leaflets descriptive of "Visqueen" polythene film have just been distributed by this subsidiary of Imperial Chemical Industries Limited. This product is an extremely tough, flexible and transparent wrapping material, is completely impervious to water, and has a very low moisture vapour transmission rate, which is unaffected by creasing or flexing. It is also said to be chemically inert, and, therefore, offers a very simple and safe means of protecting machinery, component parts and spares in storage or transit. Technical data and illustrations are also included in the leaflets.

Spray Nozzles. — T.C. Spray Finishing Systems, 5 St. James's Place, London, S.W.1.

A useful four-page pamphlet on spray nozzles for the Bede airless spray process has been distributed by this company. Simply, but in full detail, descriptions tables and illustrations are given clearly denoting the relation of nozzles and materials.

Crucible Furnaces. — The Morgan Crucible Company Ltd., Battersea Church Road, London, S.W.11.

The Morgan Miniature furnace is the main topic dealt with in a recent coloured leaflet issued by this company. A description of the use of this furnace in a technical school at Chatham is given, together with several photographs of the crucible in operation. Two new furnaces are also described and illustrated; these are the electric die-casting furnace, developed in conjunction with Birlec Limited, and also the oil-fired basin tilting furnace, which is complementary to the die-casting furnace as it is an aluminium bulk melting furnace for feeding maintaining furnaces.

Laboratory Equipment — Baird and Tatlock (London) Ltd., Chadwell Heath, Essex.

In the latest available issue of this company's Bulletin there are several interesting illustrated articles, including one dealing with "Analmatic" autotitration equipment. Another deals with inorganic analysis with the spectrophotometer, and a still further article on the Gunn-Bellani radiation integrator. There are also other notes dealing with scientific instruments and equipment.

"The Forge."—The Brockhouse Organization, 25 Hanover Square, London, W.1.

A new house magazine is introduced by this group of companies. The first issue covers sixteen pages and the contents are intended to interest the members of all companies in the group in the activities of each other. The range and variety of Brockhouse products is to be described and items of current interest will be included in each issue, dealing with products as well as personalities. This first issue has an excellent sprinkling of photographs, as well as a page of cartoons. There are 23 companies within the group.

THE STOCK EXCHANGE

Industrials Subdued And A Little Uncertain In Tone

ISSUED CAPITAL *	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 28 JANUARY +RISE —FALL		DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1957 HIGH	1957 LOW	1956 HIGH	1956 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	19/6		10	10	10 5 3	28/3	18/–	25/–	20/–
400,000	2/–	Anti-Attrition Metal	1/6		8½	7½	11 6 9	2/6	1/6	2/2½	1/6½
33,639,483	Stk. (£1)	Associated Electrical Industries ...	48/–		15	15	6 5 0	72/3	47/9	85/7½	57/3
1,590,000	1	Birfield Industries	52/6	+9d.	15	20N	5 14 3	70/–	48/9	110/7½	48/9
3,196,667	1	Birmid Industries	57/3		17½	17½	6 2 3	80/6	55/9	81/9	58/9
5,630,344	Stk. (£1)	Birmingham Small Arms	25/9	—3d.	10	8	7 15 3	33/–	21/9	39/9	20/–
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/–		5	5	6 13 3	16/–	15/–	18/6	14/10½
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/6		6	6	7 5 6	19/–	16/6	21/6	17/9
500,000	1	Bolton (Thos.) & Sons	28/9		12½	12½	8 14 0	30/3	28/9	31/–	29/6
300,000	1	Ditto Pref. 5%	15/3		5	5	6 11 3	16/9	14/3	18/1½	15/9
160,000	1	Booth (James) & Co. Cum. Pref. 7%	19/–		7	7	7 7 3	22/3	18/9	23/–	21/6
9,000,000	Stk. (£1)	British Aluminium Co.	43/9	+6d.	12	12	5 9 9	72/–	38/3	81/10½	40/6
1,500,000	Stk. (£1)	Ditto Pref. 6%	18/6		6	6	6 9 9	21/6	18/–	21/10½	19/6
15,000,000	Stk. (£1)	British Insulated Callender's Cables	41/6	+1/6	12½	12½	6 0 6	55/–	40/–	54/9	45/3
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	29/3	—9d.	10	15N	6 16 9	39/–	29/6	63/6	32/3
600,000	Stk. (5/–)	Canning (W.) & Co.	20/6	—3d.	25	25	6 2 0	24/6	19/3	25/6	19/–
60,484	1/–	Carr (Chas.)	2/3		25	25	11 2 3	3/6	2/1½	3/—	2/4½
150,000	2/–	Case (Alfred) & Co. Ltd.	4/6	—1½d.	25	25	11 2 3	4/6	4/–	5/–	3/10½
555,000	1	Clifford (Chas.) Ltd.	16/1½	+4½d.	10	15N	12 8 0	20/6	15/9	35/–	21/1½
45,000	1	Ditto Cum. Pref. 6%	15/10½		6	6	7 11 3	17/6	16/–	19/–	17/9
250,000	2/–	Coley Metals	4/4½	—1½d.	25	25	11 8 6	5/7½	3/9	5/1½	3/7½
8,730,596	1	Cons. Zinc Corp.†	47/–	—4/–	22½	22½	9 11 6	92/6	49/–	70/7½	46/3
1,136,233	1	Davy & United	47/6	—6d.	15	12½	6 6 3	60/6	42/6	50/6	41/3
2,750,000	5/–	Delta Metal	20/3	—3d.	*17½	*17½	4 6 6	28/6	19/–	25/9	18/3
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	25/6	+1/6	15B	22½	9 16 0	38/6	25/–	39/7½	30/–
500,000	1	Evered & Co.	41/–		15	15	7 6 3	52/9	42/–	56/–	52/–
18,000,000	Stk. (£1)	General Electric Co.	37/9		14	12½	7 8 0	59/–	38/–	65/6	41/3
1,250,000	Stk. (10/–)	General Refractories Ltd.	27/6	—3d.	17½	17½	6 7 3	37/–	26/9	33/6	24/1½
401,240	1	Gibbons (Dudley) Ltd.	64/–	—6d.	15	12	4 13 9	71/–	53/–	54/–	50/–
750,000	5/–	Glacier Metal Co. Ltd.	5/9		11½	11½	10 0 0	8/1½	5/10½	8/6	6/3
1,750,000	5/–	Glynwed Tubes	13/–	+3d.	20	20	7 13 9	18/–	12/6	18/3	15/9
3,614,032	10/–	Goodlass Wall & Lead Industries ...	29/–	—3d.	18	16	6 4 3	37/3	28/9	34/7½	26/10½
342,195	1	Greenwood & Batley	46/10½		17½	17½	7 9 3	50/–	46/–	48/–	45/–
396,000	5/–	Harrison (B'ham) Ord.	11/6		*15	*30‡	6 10 6	16/9	12/4½	42/9	14/10½
150,000	1	Ditto Cum. Pref. 7%	18/9		7	7	7 9 3	22/3	18/7½	25/–	22/–
1,075,167	5/–	Heenan Group	7/3	+3d.	10	20‡	6 18 0	10/4½	6/9	‖8/6	6/6½
142,045,750	Stk. (£1)	Imperial Chemical Industries ...	38/3	—4½d.	10	10	5 4 6	46/6	36/3	50/–	36/6
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5%	17/–		5	5	5 18 0	18/6	15/6	19/9	16/3
14,584,025	**	International Nickel	140	+2	$3.75	$3.75	4 16 0	222	130	210	141½
430,000	5/–	Jenks (E. P.), Ltd.	15/6	+3d.	27½ ϕ	27½	8 6 9	18/10½	15/1½	18/3	15/–
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	15/–		5	5	6 13 3	17/–	14/6	18/–	16/3
3,987,435	1	Ditto Ord.	40/6	+6d.	10	9	4 18 9	58/9	40/–	52/–	40/9
600,000	10/–	Keith, Blackman	16/3		15	15	9 4 6	21/9	15/–	25/10½	18/9
160,000	4/–	London Aluminium	4/–	—1½d.	10	5	10 0 0	6/9	3/6	8/–	5/–
2,400,000	1	London Elec. Wire & Smith's Ord....	41/–	+3d.	12½	12½	6 2 0	54/6	41/–	52/9	42/6
400,000	1	Ditto Pref.	22/9		7½	7½	6 11 9	25/3	21/9	26/–	24/–
765,012	1	McKechnie Brothers Ord.	35/–	—2/6	15	15	8 11 6	48/9	37/6	58/1½	50/6
1,530,024	1	Ditto A Ord.	32/6	—3/9	15	15	9 4 6	47/6	36/–	58/–	46/9
1,108,268	5/–	Manganese Bronze & Brass	9/3	+1½d.	27½‡	25	7 8 9	21/10½	7/6	18/9	15/4½
50,628	6/–	Ditto (7½% N.C. Pref.)	5/9		7½	7½	7 16 6	6/6	5/–	6/3	5/6
13,098,855	Stk. (£1)	Metal Box	42/3	+1½d.	20‡	15M	4 14 9	59/–	40/3	54/6	41/6
415,760	Stk. (2/–)	Metal Traders	6/6	+1½d.	50	50	15 7 9	8/–	6/3	8/–	5/10½
160,000	1	Mint (The) Birmingham	22/9		10	10	8 15 9	25/–	21/6	25/3	22/6
80,000	5	Ditto Pref. 6%	83/6		6	6	7 3 9	90/6	83/6	92/6	84/6
3,064,930	Stk. (£1)	Morgan Crucible A	35/6	—3d.	10	11	5 12 9	54/–	35/–	48/3	38/6
1,600,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/3		5½	5½	6 7 6	19/3	16/–	20/7½	18/–
2,200,000	Stk. (£1)	Murex	55/3	—3d.	20	20	7 4 9	79/9	57/–	74/–	60/–
468,000	5/–	Ratcliffs (Great Bridge)	6/10½		10	10Y	7 5 6	8/–	6/10½	10/3	7/–
234,960	10/–	Sanderson Bros. & Newbould ...	26/6	+1/–	27½D	27½	6 18 3	41/–	24/9	38/–	33/–
1,365,000	Stk. (5/–)	Serck Radiators	11/3		17½Z	15	5 3 9	18/10½	11/6	16/3	12/3
600,400	Stk. (£1)	Stone (J.) & Co. (Holdings)	43/9	—3d.	16	16	7 6 6	57/6	43/9	59/6	49/–
600,000	1	Ditto Cum. Pref. 6½%	20/–	+1½d.	6½	6½	6 10 0	21/9	18/9	21/9	20/3
14,494,862	Stk. (£1)	Tube Investments Ord.	51/1½	—9d.	15	15	5 17 6	70/9	50/6	70/7½	50/9
41,000,000	Stk. (£1)	Vickers	30/1½	—1½d.	10	10	6 12 9	46/–	29/–	44/6	32/4½
750,000	Stk. (£1)	Ditto Pref. 5%	15/6		5	5	6 9 0	18/–	14/–	18/7½	15/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	22/–		*5	*5	7 0 3A	24/9	20/7½	25/6	22/6
2,200,000	1	Ward (Thos. W.), Ord.	73/6	+9d.	20	15	5 8 9	83/–	64/–	69/3	58/9
2,666,034	Stk. (£1)	Westinghouse Brake	33/4½		10	18P	6 0 0	85/–	29/1½	100/6	68/–
225,000	2/–	Wolverhampton Die-Casting ...	7/6		25	40	6 13 3	10/1½	7/–	14/10½	8/–
591,000	5/–	Wolverhampton Metal	15/6	+4½d.	27½	27½	8 17 6	22/3	14/9	21/10½	16/–
78,465	2/6	Wright, Bindley & Gell	3/7½	+1½d.	20	17½E	13 15 9	3/9	2/7½	3/9	2/6
124,140	1	Ditto Cum. Pref. 6%	11/6		6	6	10 8 9	12/6	11/3	14/–	12/4½
150,000	1/–	Zinc Alloy Rust Proof	2/10½		40D	33½	9 5 6	5/–	2/9	4/–	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% Capitalized issue. ⊕ The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. H and 200% capitalized issue. M and 10% capitalized issue. Y and 25% capitalized issue. ‖Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/– per share or £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And proposed 100% capitalized issue.